Volume 50, No. 1
January 9, 1961

OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

AMERICAN DYESTUFF REPORTER

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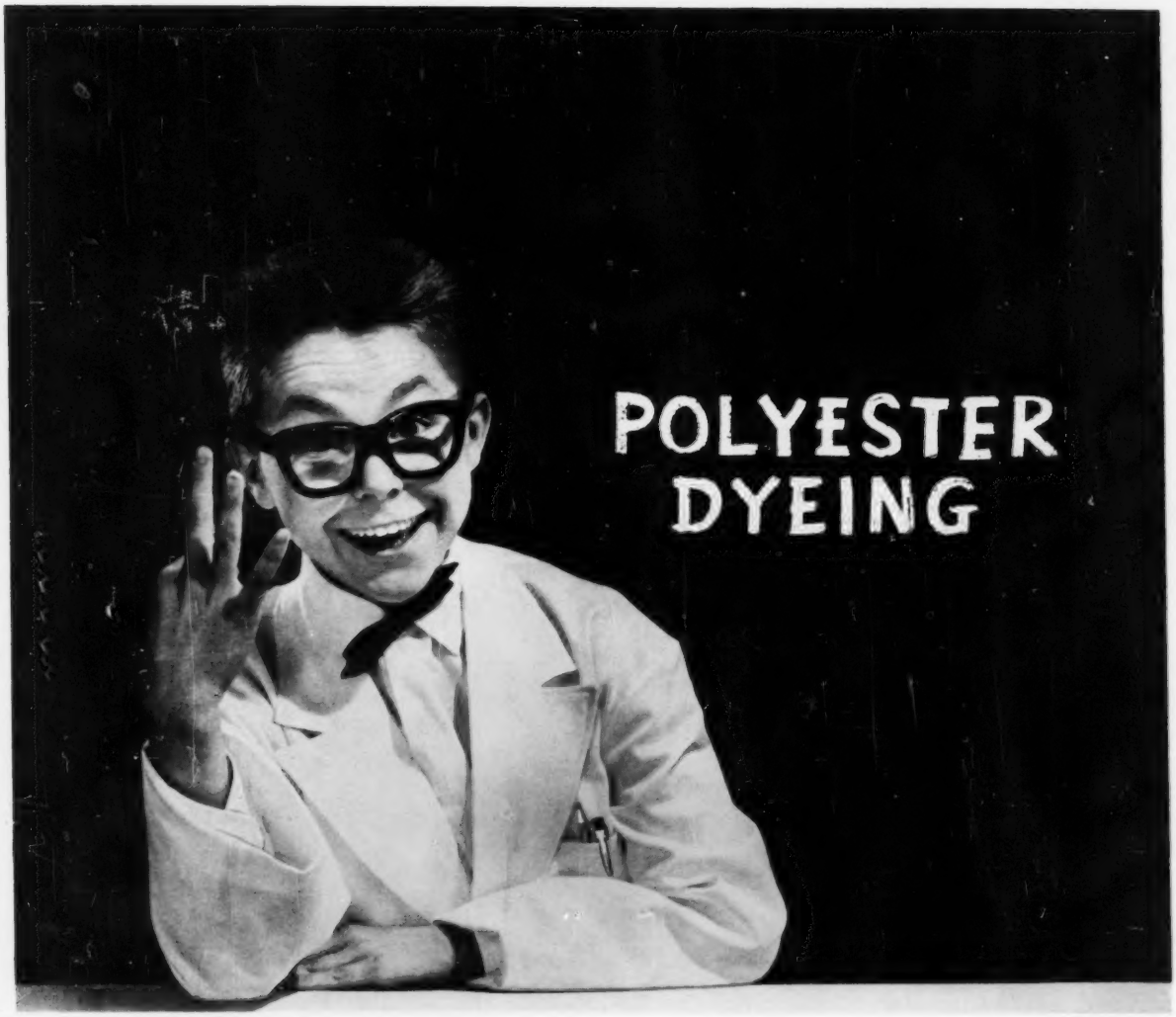

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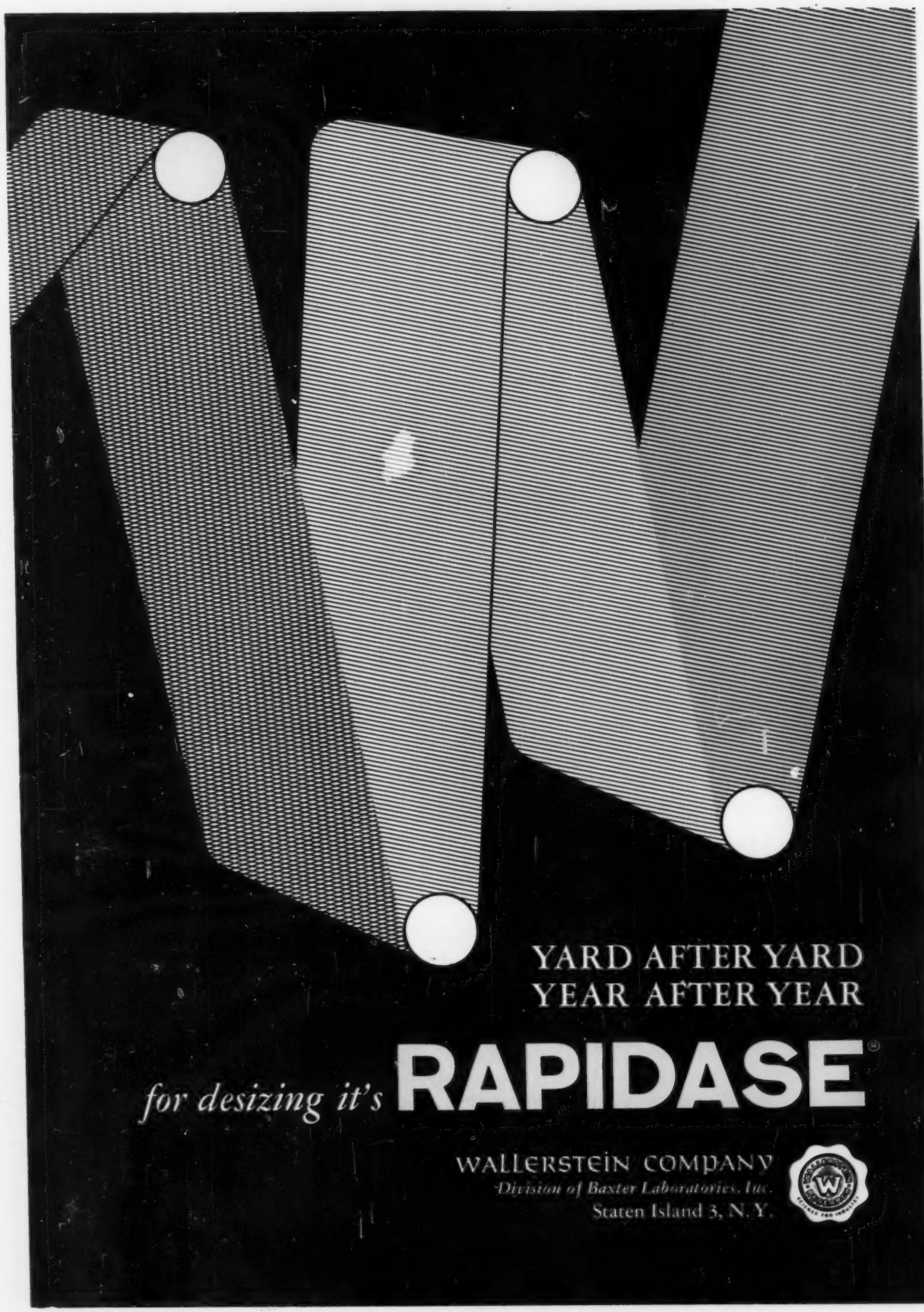
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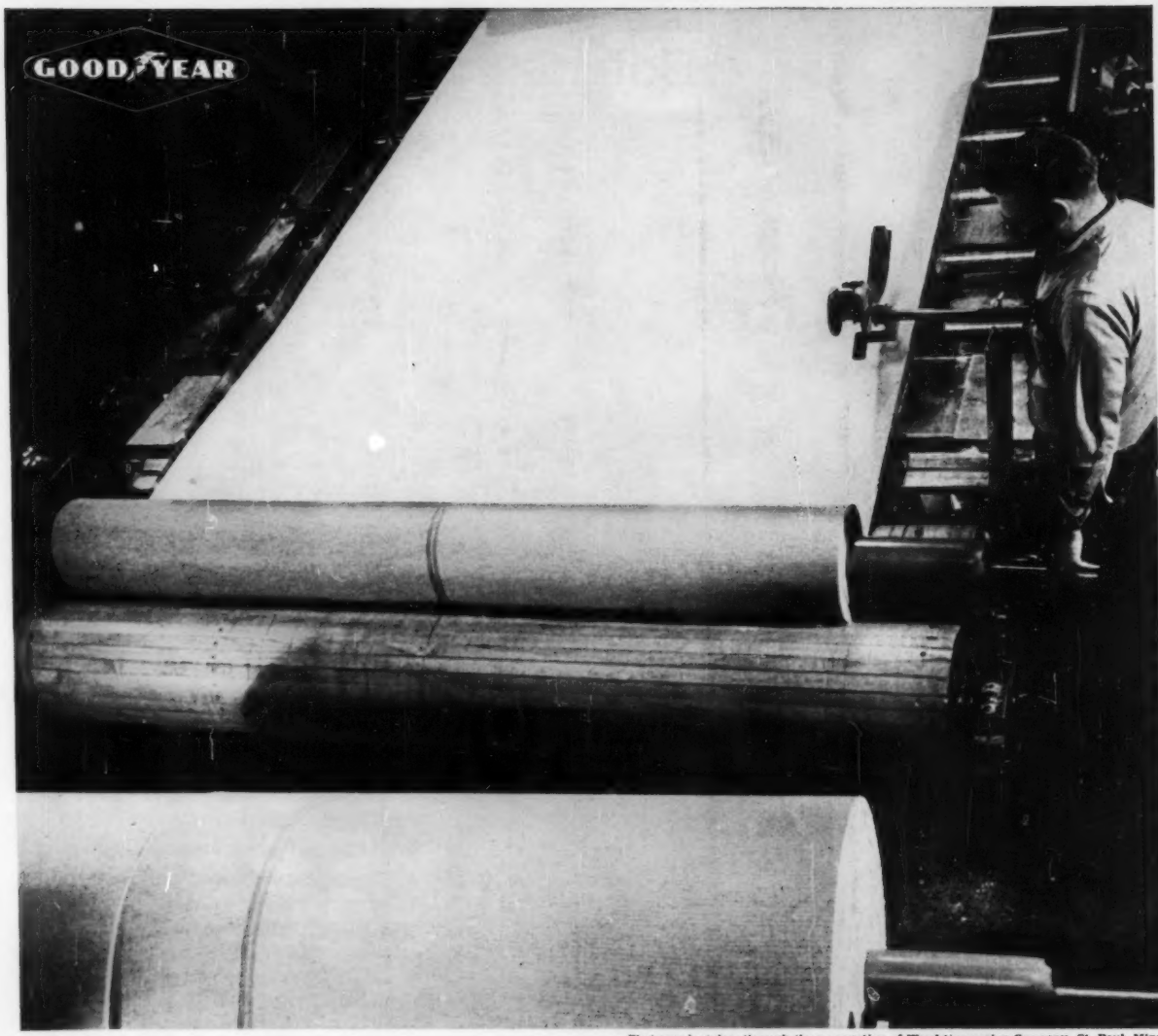

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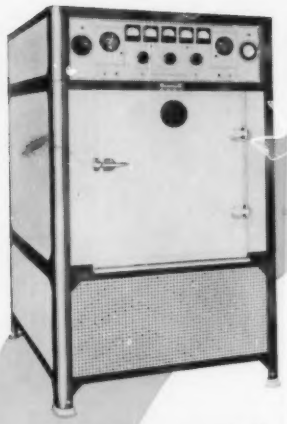

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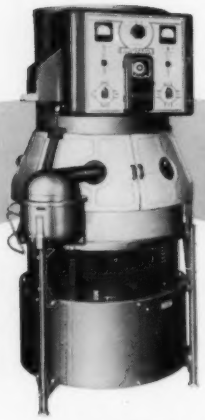

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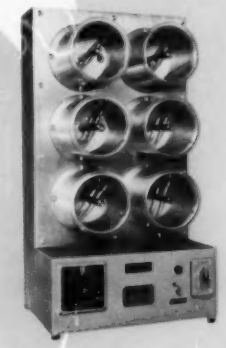

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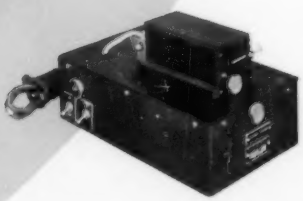

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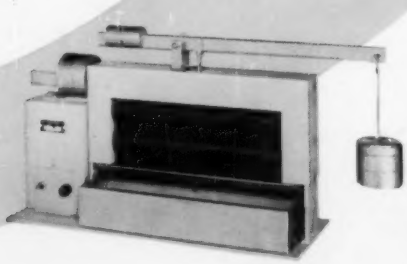

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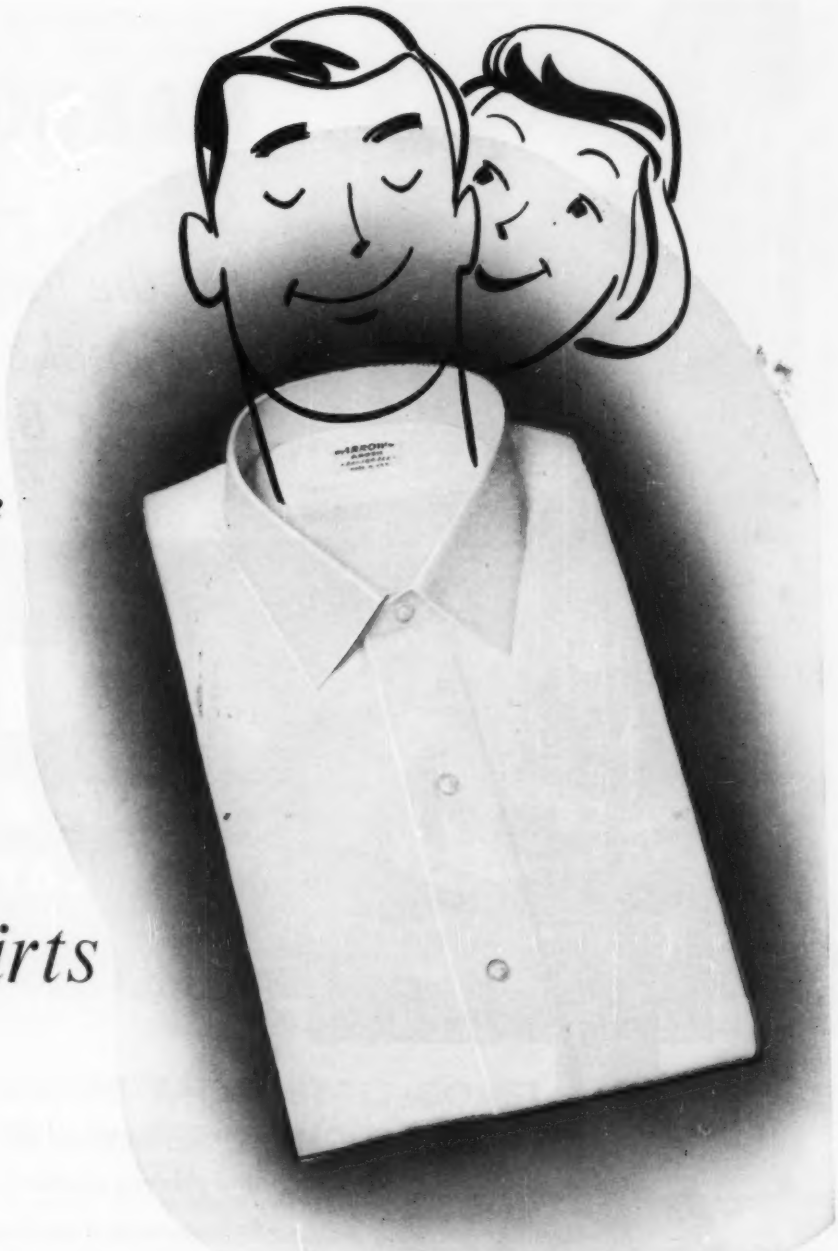

You always look your best in an Arrow shirt . . . there's good reason. Cluett, Peabody & Co., Inc., maker of Arrow shirts, puts full emphasis on highest quality production. And that's the major reason they have adopted the *Solvay Activated Hydrogen Peroxide Bleaching Process.* It produces better hand and superior whiteness without harm to the goods.

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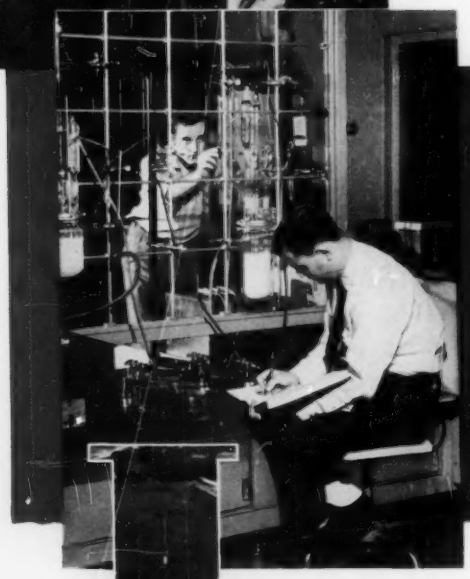

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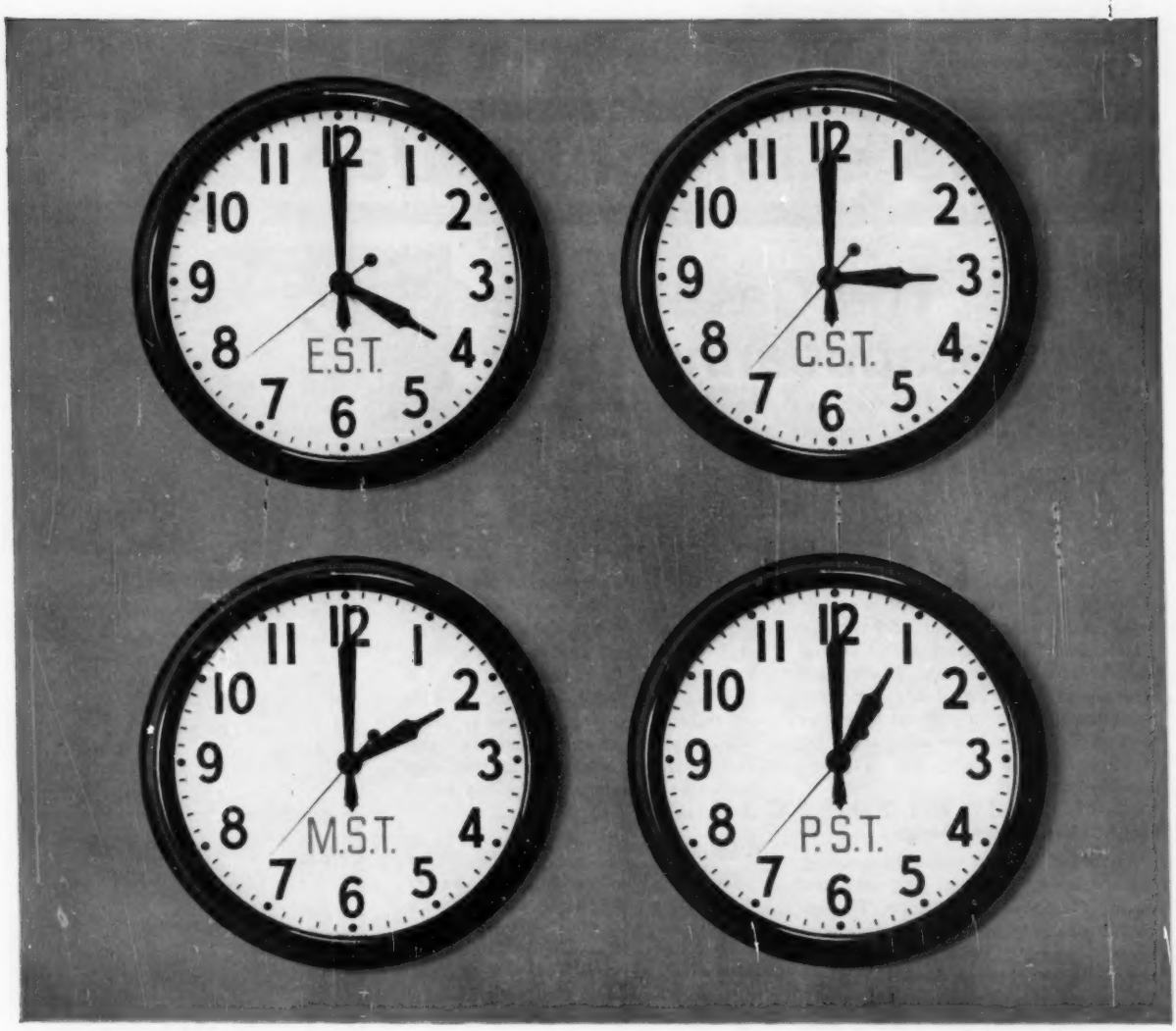

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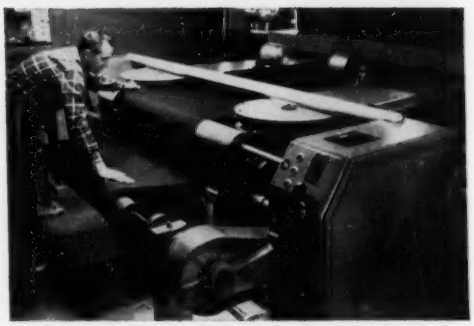
one of a series in which we present some facts and express some opinions to help textile chemists solve dyeing and finishing problems

The subject for January

The Case of the Disappearing Dyes

Profit by the experience of this dyer who learned that "economy" polyester dyes cost too much



A major dyehouse in New Jersey was having trouble with a particular polyester/cotton blend. One 10,000 yard lot had already been rejected and several others were questionable. Blacks and grays were on the green side; the blues were too light; yet the Head Dyer was certain the fabrics were on shade after dyeing. What's more, his retained samples proved it.

Heat Causes Color Change

The Head Finisher correctly reasoned the red dyes being used had sublimed during the finishing operation. The resulting decrease in the red component caused the drift to green. The blues also became lighter through dye sublimation. Even worse, the fabrics would probably continue to change color after they reached the consumer because of their poor fastness to dry cleaning and ironing.

Why Not Redye?

Redyeing fabrics containing polyester fibers seldom gives satisfactory results. The heat set given the fabric during finishing to maintain dimensional stability greatly reduces the dyeability of the polyester fibers. And a second trip through the finishing range adversely affects the hand of the fabric.

Enter Eastman

At this point, the dyer called in an Eastman technical representative for help *even though our dyes were not being used.* The Eastman representative observed the dyeing and finishing procedures, examined the fabric, and brought a sample of the greige goods to our nearby Textile Laboratory at Lodi, New Jersey.

A Recommendation

After studying the color changing problem, textile chemists at our laboratory recommended use of a group of superior polyester dyes known for their stability to heat and light: Eastman Polyester Blue GLF, Polyester Yellow W and Polyester Red 2G. Although selected for their outstanding fastness to sublimation and dry cleaning, these dyes also deliver exceptional wash fastness—an important advantage for the end use of the fabric.

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Dye formulas matching the master swatches were developed and tested for stability in the dyer's finishing range. Then a plant run was made. The results were excellent. The dyer adopted the dyes, and has since processed and delivered many thousands of yards of finished fabric to the complete satisfaction of his customer.

The Moral

Eastman Polyester Dyes plus interested technical assistance by men who have spent years in the field of synthetic textiles are your best insurance against costly redyeing, rejected goods and the attendant risk of losing the account.

Eastman Polyester Dyes

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And Technical Service, Too

Included with every pound of Eastman Polyester Dyes you buy are the technical resources and extensive experience of a pioneer in fabrics and dyes. Our facilities and knowledge are freely available to help you get the most effective use out of this outstanding line of dyes.

THE PRODUCT FOR JANUARY

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Polyester Yellow RL	Polyester Blue GR
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Polyester Yellow 5R	Polyester Blue 3RL
Polyester Red B	Polyester Blue BLF
Polyester Red 2G	Polyester Blue GB
Polyester Dark Red FL	Polyester Navy G
Polyester Pink RL	Polyester Violet R
Polyester Pink LB	Polyester Brown 3RL
Polyester Brilliant Orange 2RL	Polyester Black RB

Polyester Diazo Black B

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AMERICAN
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DEVOTED TO TEXTILE WET-PROCESSING

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A SURVEY OF THE EFFECT OF LIGHT ON COTTON AND OTHER CELLULOSIC FABRICS

HELEN M ROBINSON and WILSON A REEVES

Southern Regional Research Laboratory[1]

New Orleans, La

In 1924, Cunliffe (*43*) of the British Cotton Industry Research Association had published in the *Journal of the Textile Institute* a critical bibliography, "The Action of Light on Dyes Applied to Cotton Fabrics." His work covered the literature up to 1924, so far as dyes were concerned. In 1948, Appleby (*13*) of the Southern Regional Research Laboratory had published in American Dyestuff Reporter "The Action of Light on Textile Materials." This paper reported on textile materials in general and evaluated the literature from 1920 to April 1948. The purpose of the present bibliography is to consolidate work reported from April 1948 through 1958 on the effect of light on cotton and other cellulosic fabrics. A very few earlier papers are included which report pioneer work which has since been reviewed and continued. Also included are a few particularly pertinent papers which were published early in 1959.

I. LIGHT

LIGHT is a form of radiation, traveling in waves. Wavelength, the distance between two peaks of the wave, is measured in cms or angstroms ($A = 10^{-8}$ cms). As the wavelength increases, the ability of absorbed light to produce chemical changes decreases (*51*). The energy furnished by the light is dependent on the wavelength. The change in energy ($\triangle E$) which produces the radiation is equal to the frequency of the radiation, (1/wavelength) $\times$ Planck's constant. ($\triangle E = hv$).

DIVISION OF THE SPECTRUM———Gamma rays and x-rays have exceedingly short wavelength and therefore possess great energy. Gamma rays have wavelengths less than 0.06 A, while the x-rays are in the range between 0.06-2.0 A. Ultraviolet rays range from 2.0 to 3900 A. However, in this study this point is of only theoretical interest since solar ultraviolet below 2700 A never reaches the earth. The shorter rays are absorbed by the ozone and air layer surrounding the earth. The extreme lower limit is probably 2700 A and usually the ultraviolet light reaching us is between 3500 and 3900 A. Visible radiation is in the range of about 4000 to 7000 A. Figure 1 gives the natural divisions of the spectrum and includes a comparison of the different bands of light generally used in studying the effects of light on cellulose.

DIVISIONS FOR STUDY———For experimental purposes and study, a particular range of light waves may be segregated. Certain sections of the spectrum may be blocked off so that the effect of the remainder may be studied. Ordinary clear glass absorbs light up to at least 3200 A and usually much higher. This excludes almost all of the ultraviolet region which is the region accountable for much of the light damage to fabric. If a mercury vapor lamp with a glass cover is used for a light source, it will make available the ultraviolet range 3200-4000 A. If the lamp is surrounded by a quartz envelope instead of glass, the range will be approximately as low as 2100 A (*76*). A Xenon lamp gives light very similar to a mercury lamp but with many more lines, and the range is farther into the infrared. Some investigators use a corex glass enclosed carbon arc (*39, 53, 58*). This covers a wide range, 4000 A and higher. Dean, Fleming and O'Connor (*44*) used an unfiltered carbon arc light in accelerated weathering work with cotton and other textiles (2200-11,000 A).

Cooper and Hawkins (*41*) considered the different sources of light for studies of this nature and concluded that none of the light sources has a spectral distribution similar to sunlight. The enclosed flame arc resembles sunlight only to the extent that the proportion of radiant power emitted in the region 3000-4300 A is approximately the same as that of noon summer sunlight. In other regions of the spectrum the proportions emitted by the arc differ considerably from those given by the sun. The two principal factors affecting the distribution of energy in the spectrum of the enclosed flame arc are the composition of the surrounding atmosphere and asymmetrical burning of the arc. Variations of this kind can be minimized by avoiding air leaks, eg, between globe and bedplate, and by avoiding disturbing magnetic fields or other sources of misalignment of the arc. The total radiation depends upon the electrical power input, which should vary as little as

[1]One of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U S Department of Agriculture.

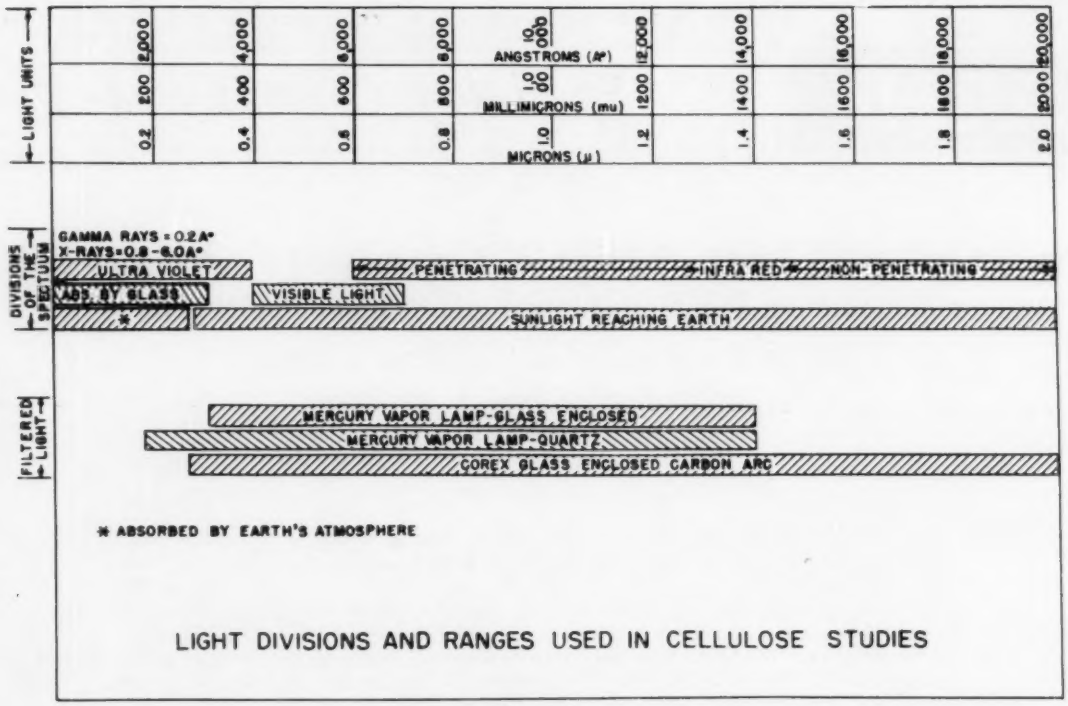

Figure 1

possible in both current and voltage. Fumes deposited on the globe from the arc cause the radiation to be diffused rather than absorbed. The high-intensity arc is, of all the light sources examined, the nearest to noon sunlight in its spectral characteristics. This type of arc, however, cannot be left to burn unattended for long periods.

McLaren (*88*) gives superimposed comparative curves of maximum sunlight and enclosed carbon arc (2kw). He also compares natural radiation, ie, radiation of sun and sky on horizontal plane in medium latitudes with light from a xenon arc Xe 1500, filtered through the glass-water filter in the xenon test. These latter two are remarkably similar.

SEASONAL AND CLIMATIC INFLUENCES ON SUNLIGHT———Radiation received at the surface of the earth from the sun is subject to wide variations both in total intensity and in distribution of energy in the spectrum. The most important factor in influencing the radiation characteristics is the effective thickness and state of the earth's atmosphere. It follows from this that such factors as season of year, time of day, altitude of place, and amout of water vapor, dust, and other absorbing materials in the atmosphere all have a marked influence on the radiation characteristics. All these sources of difference are mutiplied by geographical and seasonal differences. In the winter, although the sun is closer to the earth, the direction of the rays is slanted and therefore the same amount of light is spread over a larger area. Also, of course, the time the sun shines in 24 hours is less.

Brode (*30*) discussed the many difficulties met with in papers dealing with light both in textbooks and journals. He made an attempt to determine the accepted nomenclature systems, and recommended certain forms where there is too much confusion. Examples of data and graphical relation of values were given to show the relative form of data as presented by different systems.

II. THE THEORY OF THE DEGRADATION OF CELLULOSE BY LIGHT

Light degrades cotton cellulose. The exact mechanism through which degradation takes place is perhaps not yet known, but it is generally agreed to be oxidative in nature. Race (*102*) suggested the following possibilities when cellulose is exposed to light: a) weakening of glycosidic linkages to an extent that they can subsequently be broken under direct attack by gaseous oxygen; b) an intramolecular rearrangement within individual anhydroglucose units, the modified structure being stable in nitrogen but unstable in oxygen; c) the possibility of the rupture of crosslinkages between the cellulose chains; (reactions a, b, and c are purely photochemical); d) rupture in the presence of atmospheric oxygen of the linkages modified or weakened by radiation; and e) direct oxidation of hydroxyl groups, requiring both oxygen and ultraviolet radiation. Reactions d and e occur concurrently with a, b, and c when oxygen is present during exposure, and they occur also as postexposure reactions, their extent depending upon the duration of exposure.

Launer and Wilson (*81*) studied the effect of water vapor and oxygen in far and near ultraviolet regions. Radiation at 30-40°C of sheets of paper of varying cellulose content and degree of polymerization showed that in the far ultraviolet, water vapor retards the decrease in alpha-cellulose and in molecular weight, whereas oxygen has no effect. In the near ultraviolet the reverse is found to be true.

Ashton, Clibbens, and Probert (*14*) reported that reaction will take place in dry air if a sensitizer such as very finely precipitated zinc oxide is in extremely intimate contact with the fabric.

Volman (*126*) studied the vapor phase photodecomposition of hydrogen peroxide by light of wavelength 2537 A. The reaction products were found to be water and oxygen only. Volman stated that the rate of reaction is independent of temperature and is not affected

by addition of oxygen, nitrogen, or water to the reaction mixture.

Bates and Nicolet (*21*) studied the photochemistry of atmospheric water vapor. Solar radiation dissociates water vapor into H atoms and OH radicals, H_2 and H_2O_2, and perhydroxyl with allotropic forms of oxygen.

Agster and Holzinger (*12*) ran a series of tests with fibers in glass tubes exposed to sunlight for 10 weeks and to ultraviolet radiation for 40 hours. They varied amounts of water and oxygen present. The presence or absence of oxygen caused no difference in fiber behavior in the absence of moisture but in its presence, oxygen caused increased degradation owing to increased peroxide formation.

Loiseleur (*82*) stated that it is possible to transform organic molecules of low molecular weight into peroxides by action of x-rays, ultraviolet light, or ultrasonics. Owing to their instability, these peroxides may decompose and produce chemical syntheses by condensation with other molecules. To obtain the desired effect the oxygen should be present in a readily activated form.

MODES OF DEGRADATION———Two kinds of reaction, photolysis and photosensitization, may be involved when cellulose is degraded by light, and a third, heat, which involves light but is not photochemical, since no light is absorbed.

Photolysis. The first of these reactions, photolysis, is a true photochemical reaction of cellulose. When sufficient light of proper wavelength is absorbed by cellulose itself to cause disruption of a chemical bond, the reaction is referred to as photolysis. Pure cellulose does not absorb light except that of extremely low wavelength, far below the limiting 2700 A of solar ultraviolet reaching the earth. Therefore, direct degradation of cellulose by light on earth takes place only in the laboratory under carefully controlled conditions of light source. This will be mentioned later when the Weather-Ometer is considered.

Kujirai (*76*) showed that cellulose film absorbed strongly below 2000 A and weakly between 2000 and 4000 A. Both natural and regenerated cellulose suffered degradation by continuous radiation from a quartz arc lamp. Flynn, Wilson, and Morrow (*55*) radiated cellulose in a vacuum with ultraviolet light (2537 A) evolving H_2, CO, and CO_2, CHO- and -COOH groups, and the degree of polymerization decreased markedly.

Photosensitization. This type of reaction is a secondary photochemical reaction. Cotton fabric itself does not absorb near ultraviolet or visible light. The primary action (which is photochemical) is between the light and foreign matter present in the cellulose. An added substance, either as an impurity or added treatment, can absorb light and shift the effective light range limits. This second substance, the sensitizer, carries the absorbed energy to the reacting molecules of the fabric. Sensitizers absorb the light and cause a reaction changing water or oxygen present either to hydrogen peroxide or ozone. These, in turn, react with the cellulose in a straight chemical reaction to degrade it. Race (*102*) suggested that possibly the cotton substrate acts as an activator and oxygen is converted to ozone (photosensitization of the oxygen) which then degrades the cellulose, or the ultraviolet radiation activates without degrading the cellulose which is thereafter susceptible to attack by gaseous oxygen. The effects of photosensitization will vary tremendously, depending on the amount of moisture and oxygen present.

Cooper (*42*) pointed out that the light energy absorbed must be transformed in one particular way. It is not sufficient that light should merely be absorbed. Absorption alone could lead to other types of transformation processes, such as heating or fluorescence. The absorbed radiation must be of appropriate wavelength to excite the molecules of the substance so that they enter into chemical reaction or, in extreme cases, are dissociated.

The first reaction comprising the absorption of light and the resulting photochemical reaction is between the light waves and the sensitizer. In this type of reaction hydrogen peroxide or ozone may be formed, depending, as mentioned above, on the amount of moisture and oxygen present. The second reaction is purely chemical and takes place between these oxidation products and th cotton cellulose.

Schurz (*113*) reported that oxycellulose could be formed by peroxide oxidation of native or regenerated cellulose. Oxycelluloses may be insoluble, alkali soluble, or water soluble, depending on the length of the final degraded cellulose chains. Oxycellulose, the principal constituent of the so-called residual hemicelluloses and primarily responsible for the degradative effects of hemicelluloses in viscose manufacture, is an intermediate product in the yellowing of chemical pulp. Light and oxygen convert the cellulose to oxycellulose which is then degraded further to strongly colored low molecular weight compounds.

Some insight has been shed on the mechanism of the photo-oxidation reaction by Lock and coworkers (*5*) who used sensitizing dyes with simple alcoholic compounds. Their work indicated that the dye first absorbs the light, then the excited dye molecule extracts a hydrogen from the cellulose molecule. Atmospheric oxygen is then capable of adding to the cellulose to produce a peroxy-free radical, which subsequently results in breaking the cellulose chain.

Heat. This involves both fabric and light but is not photochemical in nature because no light is absorbed. However, intense heat does have a destructive effect on cellulose and as such will be considered here. Heat will degrade cotton by increasing the rate of chemical reactions. In work with the Fade-Ometer (*2*) it was reported that temperature has much more effect on both fabric and dyes than does an increase in relative humidity. Heyl and Kramer (*64*) discussed the resistance of treated fabric to low ultraviolet and visible radiation, and also the protection against heat radiation and radiation of hot bodies. Prati (*101*) studied the heat effect on nylon 66 at 128°C. For 15-20 hours no effect was observed, and then there was a definite loss in breaking strength and reduction in viscosity when heating was continued. Kleinert and Wincor (*73*) said that increased carboxyl content in cellulose is indicative of sensitivity to thermal degradation.

Wilhelm and Smith (*129*) studied the radiant heat drying of textile materials and observed that radiant energy penetration appeared to take place during the course of drying. As beams of radiant energy pass through a textile they are reflected from the surfaces of the fibers and are refracted by passing through individual fibers. A reflected beam, or one which has passed through and emerged from a fiber may assume a path in any direction. A fraction of the radiant beam is absorbed by the fibers of a cloth with each fiber surface reflection and with each passage through a fiber. If the cloth is not too thick, some of the incident light

eventually finds its way through the tortuous path within the cloth and emerges as transmitted light. A part of the incident light which has entered the cloth will again find its way out of the cloth in the direction of the light source, and this is reflected light. The amount of light converted to thermal energy is absorbed radiation. Wilhelm and Smith describe quantitatively the transmittance, reflectance, and absorptance of light, or radiant energy, by bulk textile fibers in terms of the numbers of fibers. They concluded that the nature of the fabric fiber affected transmittance, while construction of the fabric did not, and that the important variable is the average number of fibers in the path of illumination. Dyes markedly affected transmittance with an enormous decrease for sulfur black dyes. They developed equations for the transmittance, reflectance, and absorptance of fabrics.

Baskin and Kaplan (*20*) pointed out the possibility that heat-induced hydrolytic breakdown products of anthraquinone-2,6-disulfonic acid on treated cotton duck are responsible in part for tensile strength loss of the duck.

Buckwalter (34) suggested that aqueous 2,2′-diaminodialkyl sulfides protect cotton and rayon fibers against heat.

III. STUDIES ON THE METHODS OF TESTING FABRICS EXPOSED TO LIGHT

Damage to textiles can be measured in various ways, breaking strength loss, cuprammonium fluidity, methylene blue number, tearing strength, etc. Tendering of a fabric is usually measured by the breaking strength test or fluidity measurements. Goldthwait and Robinson (*61*) pointed out that it cannot be assumed that breaking strength results and fluidity values of cotton fabrics exposed to outdoor weather measure the same property, nor that this property may be described interchangeably as degradation, deterioration, or breakdown. They used deterioration to refer to reduction in desirable useful physical properties and degradation to describe a change of a chemical nature. Breaking strength measures the ability of a fabric to resist rupture when placed under tension, whereas fluidity is a measure of the breakdown of the cellulose chain length, since it measures average degree of polymerization. If, during outdoor weathering the cellulose chain breaks close to the end to produce a water-soluble product that is leached out, the reduction in average degree of polymerization is not great. If the chain breaks in the center of the molecule to produce insoluble molecules, this affects the average a great deal more. With this in mind, it is clear that the loss in breaking strength may be high, whereas the change in fluidity measurements may or may not be large. Thus, it is obvious that the two tests do not measure the same quantity.

Teasler and Hefti (*124*) used cuprammonium fluidity and the mushroom head reaction to follow the degradation with time of cotton exposed to neutron streams and gamma radiation. This latter test is a microscopic examination of the damaged fibers. It measures the change in area of thin sections of fibers when they are acted upon by strong caustic soda.

Rusznak, Fehervari, and Deak (*106*) determined the degradation of cotton under the influence of light, air, and moisture by degree of polymerization, copper number, and carboxyl groups of nitrated samples (one bleached and two dyed). Results showed that the rate of degradation was lowest for the cotton fabric dyed red (CI Direct Red 46), somewhat higher for the blue (CI Direct Blue 1) fabric, and highest for the undyed samples. These workers claimed that this indicated that the degradation rate of cellulose during radiation may be checked to a certain extent by the oxygen consumption of the oxidizable dye.

Fabrics to be weathered outdoors are usually placed on racks facing south, at a 45° angle. Climatic differences account for many of the wide variations in data published on fabrics exposed outdoors. For this reason it is well to run tests simultaneously in several different widely scattered parts of the country. Exposures should, for best results, cover a year, if possible. Up to three or even four years of outdoor exposure is necessary to evaluate heavy fabrics and coated fabrics such as those used in awnings. In the experience of the authors it is not too important what time of year the sample is put out as long as a full year is covered. Outdoor samples may be openly exposed to the complete solar spectrum or exposed under a glass cover to limit the ultraviolet exposure. For all these reasons weathering results are valid only for the particular conditions, time, and place of exposure.

To shorten the exposure time, samples are sometimes irradiated in a Weather-Ometer. This instrument exposes the samples to light and water, the amounts and intensities of each being adjustable. Correlation of Weather-Ometer weathering with outdoor exposures is difficult. The light source, the carbon arc, varies in intensity with time, and it also supplies light farther into the ultraviolet than outdoor sunlight. This latter fact is perhaps a very significant difference. If filters are used to cut down the light to more comparable wavelengths, there is very little time saved by using the instrument.

Cooper and Hawkins (*41*) gave an excellent description of the various light sources, the range they cover, their effectiveness and accuracy. Lyle (*83*) described the construction and operation of accelerated aging cabinets in which textiles and other materials can be exposed to the radiations of a Fade-Ometer, with all factors under satisfactory control. The equipment also provides the means of combining light exposure of fabrics with exposure to other conditions. For example, fabrics may be exposed at different temperatures and humidities and in atmospheres of different gases, and the fabrics may be alternatively exposed to light and saturated with liquids, exposed to light and laundered, or drycleaned, or exposed to light and abraded. The exposure cabinets present a further advantage in that a sufficiently large specimen of fabric is used to permit observations on strength, shrinkage, and color change to be made following on exposure treatment.

National and international committees (*98, 120*) are still working on the problem of developing useful comparative tests for studying the effect of light on fabrics. A test for determining strength retention or colorfastness to light should not only be capable of yielding reproducible results, preferably in as short a time as possible, but also the results should bear a known relationship to the way in which the test material will deteriorate under actual use conditions. It is difficult to choose test conditions which will give results that can be translated into behavior in service. There is no known laboratory test method which will correlate with actual outdoor exposure tests of cotton fabrics finished with widely different chemical agents. The authors believe that this is difficult because, for one thing, the goal is to perfect a standard test without a reference standard to tie it to. Natural conditions being what they are, there is no such thing as a standard sunlight or

daylight test for compraison. Wicks (*126*) also emphasizes that fabric degradation values should be based on outdoor weathering exposures, but he pointed out that once a particular fabric or finish has shown itself to have resistance to outdoor weathering, many of the intermediate tests to determine necessary quantities, etc, can be made with the Weather-Ometer, standardized to the original outdoor weathering data, thus saving time.

MEASUREMENT OF COLOR CHANGE ON DYED FABRICS———Fading of color is most frequently assessed visually. This is difficult to duplicate, and reports of investigators do not always agree. Bulow and Horrdin (*35*) discussed the different sources of variation in assessing colorfastness to light. They made a statistical analysis and the assessment variation was found to be considerable, dependent both on differences with the same observer (time factor), and on differences between different observers (observe factor). The possibility of obtaining a truer estimate of fastness was discussed. A proper assessment of values to all the factors entering into a visual color test procedure would be very tedious, since a certain time, preferably two weeks, must elapse between the assessments in order that the observer will have no recollection of an earlier assessment, which would influence him, consciously or unconsciously. If a reduction of the other variables is wanted, several persons must take part in the assessments, and several samples from different dyeing batches must be treated. The uncertainty of a fastness grading because of this subjective factor is greater than is generally realized.

Burgess (*36*) discussed the difficulties in assessing vales of colorfastness data. He stressed the fact that the same dye may have different values alone than when in combination with others, and for each combination there is a difference. Also he shows that the same dye may have widely varying fastness on different fibers. His paper was written from the viewpoint of the dyers' practical problems.

The Fade-Ometer is an apparatus somewhat similar to the Weather-Ometer, designed to accelerate fading tests for dyes on fabrics. It also employs a carbon arc as the light source. This instrument is used extensively in quality control and in research.

Fading tests on 75 fabric samples were carried out by Babey (*17*) in direct sunlight and under glass. From these, 22 were selected for comparative Fade-Ometer tests by ten laboratories. The tabulated data indicate that both sunlight and the Fade-Ometer produce color fading of a similar character and that in many cases the rate of fading is faster in the Fade-Ometer.

McLaren (*85*) stated that there are three possible causes of the significant differences sometimes experienced between fading lamps and daylight fastness figures—spectral composition, temperature, and moisture content. Although there are marked differences between the spectral composition of fading lamps and sunlight, on theoretical grounds these would not appear to be the main cause of large discrepancies. The most likely cause is surface moisture content during exposure, and this depends on surface temperature and on the relative humidity of the surrounding air. McLaren (*86*) said further that Fade-Ometer exposures should never be regarded as a substitute for daylight testing, but merely as a means of obtaining a fairly reliable indication of actual lightfastness when time does not allow a daylight exposure to be made.

Seibert (*114*) also made a study of colorfastness using the Fade-Ometer. He pointed out that the increased use of manufactured fibers with vat dyes has increased instances of differences between lamp and sunlight results. Tests were made with different fabrics—cotton, viscose, rayon, wool, Dacron, Dynel, nylon, and Orlon. They were exposed in the open and under window glass. After being examined visually, 27 of these samples were picked for interlaboratory Fade-Ometer exposures. It was found that, while the rate of color and loss of strength varied under the different conditions of testing, the character of fading was consistently similar and interchangeable for practical testing purposes. Seibert's report said that fading and strength loss in tightly closed cabinets is, in general, more rapid than in well-ventilated cabinets but not different in character. The fugitive and very fast dyes behave similarly both in the Fade-Ometer and in sunlight when exposed under well-controlled conditions. Seibert gave a detailed description of a sunlight test cabinet and the experimental Fade-Ometer FO-2710.

The present authors also found that strength loss in closed cabinets under glass was more rapid than in glass-covered samples open to the air. Notable exceptions were fabric treated with cobalt salts and also cobalt salts combined with alizarin. While most of the samples tested faded more in direct sunlight than under window glass, in a few cases the reverse was true.

Launer (*80*) reported that the variations among fading lamps used in the textile industry are due to such things as differences in lamp models and line voltages.

McLaren (*87*) made a critical appraisal of the International Daylight Fastness test. He said the test is a reliable guide to the expected resistance to fading which will occur during use, even of the sensitive materials providing that the daylight test is carried out in the same country as that in which the fabric is used, or one whose climate is similar, and providing that the fabric does not become wet during use. He gave full details of the exposures, made all over the world, using the ISO daylight method, on which the above conclusions were based. He also presented a table listing the hours of actual sunshine per day recorded during the various exposures, the extremes being 1.9 hours in Moscow and 10.3 hours in Cairo.

Neiderhauser (*97*) reported an interesting account of a series of 38 dyes on cotton and wool, exposed to light and weather in France. The dyes represented different classes of colors. The weather tests were carried out at three different locations, for periods up to four and one-half months. Duplicate samples were exposed in the Weather-Ometer for 20, 80, and 220 hours. Sets of the AATCC lightfastness standards and the British standards (BS-1006) were also exposed, both to the weather and under glass. He reported that the results of the Weather-Ometer tests were very often "extremely remote" from those obtained in natural weather.

Friele and Selling (*58*) carried out tests on 98 fabrics (natural and man-made fibers) dyed with various dyes and showed that the carbon arc lamp gives for some synthetic fibers erroneous results. However, results obtained by using the Xenon lamp were in agreement with daylight exposures. The Xenon test results indicated that the latest measuring devices are suitable and may be recommended for the establishment of fastness standards.

Fade-Ometer test results (*2*) obtained in a special research type Fade-Ometer have been compared with results obtained in sunlight. Three relative humidity ranges selected for this work were 35%, 50%, and 65%. In addition to the nine exposure conditions

employed in the research Fade-Ometer, complete sets of the dyeings were also exposed under similar conditions in the model FDA-R Fade-Ometer. Two sets of daylight exposures were also made out-of-doors. Evaluation of test results was made by visual gradings against the Grey Scale. Each specimen was independently graded by three different members of the committee, and results were averaged. It was found, in general, that increase in temperature has much more effect on both fibers and dyestuffs than did increase in relative humidity. Also it was noted that there were many more definite patterns by fiber grouping than by dyestuff grouping.

Zart (*131*) proposed a testing procedure for quantitative determination of the damage caused by daylight on fibers or yarns exposed through glass. He described equipment, choice of samples and their preparation, manner and time of exposure, the use of the scale of blue (German Fastness Committee), the factors affecting the values, examination of the samples, determination of their wet strength and elongation and, optionally of their mean degree of polymerization and damaging factor, and the data to be included in the test report.

A total of 71 comparative exposure tests, utilizing both outdoor exposure racks and the Fade-Ometer was carried out by Schaeffer (*109*). Differences were obtained of more than one-half grade, on the Fade-Ometer tests as compared with the results obtained by exposure to daylight. Schaeffer said more tests will have to be carried out before these results could be properly evaluated. His investigations have shown that the lightfastness values obtained in the Fade-Ometer are frequently different from those resulting from exposure to daylight. Therefore, to be sure, the results obtained in the Fade-Ometer must be checked by exposing the dyeings to daylight. The rapid light exposure apparatus of Hoffman, Hoechst radiation installation (*66*) apparently can be used without hesitation for all lightfastness evaluation tests. The slight variations which sometimes occur can be disregarded because there are a number of dyestuffs which show equally large, or even larger variations.

Schmitt (*110*), working with automotive textile fabrics, encountered a complicated problem. Various synthetics and cotton blends brought the added problem of the relative lightfastness of various fibers and their location within the fabric in relation to fastness requirements. Schmitt also relates copper content of the dyestuffs to this problem. He suggests that many of the problems with this type of fabric are still unsolved because of the questionable methods used by some segments of the industry to evaluate lightfastness and the variables which occur in sun testing.

IV. EFFECT OF LIGHT ON DYED CELLULOSE

The useful life of cotton and other cellulosic goods is often limited by the quality of dye in the material, for very often fabrics are considered worn out when the aesthetic value imparted by the dye is lost by fading even though the physical properties of the goods remain satisfactory. Light is one of the major causes of color fading.

Egerton (*50, 52*) studied solid transparent films on quartz of six aminoanthraquinone compounds (1-mono-, 2-mono-, 1:4- and 1:5-di, 1:4:5-tri-, and 1:4:5:8-tetra-aminoanthraquinone). These were prepared by vacuum deposition. The action (mainly 253.7 mμ) on these solid films has been studied spectrophotometrically. The stability of the solid dye to near ultraviolet radiation and visible light is shown to be substantially greater than when the dye is present in the form of a dyeing on a polymer film. In moist air the photochemical stability of the solid dye is much less than in dry oxygen or dry nitrogen. The nature of the changes occurring as a result of irradiation in these atmospheres is also different, and reasons for these differences were discussed. The action of short-wave ultraviolet radiation (mainly 253.7 mμ) on the solid dye is shown to lead to rapid destruction of the dye. The rate is greater in dry oxygen than in dry nitrogen, and ultimately all the dye and photoproducts appear to be removed from the quartz. 2-Aminoanthraquinone is most rapidly affected by near ultraviolet and visible light but is the most stable of the six compounds to 253.7 mμ light.

From a study of the quantitative relationship between lightfastness and dye concentration, Baxter, Giles, McKee and Macauley (*23*) made certain conclusions regarding the physical state of dyes in air-dry substrates, on the basis of a simple theoretical model representing the nature of particle growth with increase in concentration. Only one type of dye-substrate system, viz, water-insoluble merocyanine dye in solid solution in collodion, has been found to obey the normal photchemical laws for ideal systems. All other systems, whether involving water-insoluble or water-soluble dyes, behave non-ideally, ie, the dye appears to exist in the form of aggregates or crystals (usually submicroscopic) and to obey a fading law in which the rate-affecting factor is the extent of the dye-air interface. Treatments which cause microscopically visible growth of such particles, eg, soaping of dyed cellulose, raise the lightfastness. Also, in accordance with prediction, the lightfastness even of water-soluble dyes is raised by increasing the porosity of the substrate. This is believed to result from the formation of larger aggregates of dye in the dry substrate. Thus, the lightfastness of direct cotton dyes is higher on highly porous (gel) cellophane film than on normal film, and on normal viscose rayon fiber than on aluminum than on the less porous chormic-acid film. A number of other examples of changes in lightfastness, believed to be due to similar physical factors, were named by Baxter and coworkers. They concluded that there is a linear relationship between the logarithm of percentage reflectance and the logarithm of total dye content for direct dyes on various viscose rayon fabrics.

Calin and Rosenberg (*38*) discussed the photochemical discoloration of a variety of dyes in the light of their chemical structure. Twenty-three dyes were given as examples.

Hopkins (*67*) considered the effects of intensity and duration of light, temperature, relative humidity, moisture content of the samples, atmospheric impurities, and catalysts in the air and in the material on fading and tendering. He said the fiber used is important, for his data showed that the same dyes on cotton are usually less fast than on bright synthetic yarns, both having been dyed with the same amount of dye. Perhaps the most important difficulty is that of "depth loss" versus "off tone" fading, eg, using a moderate depth of dyes, and comparing CI Vat 13 with CI Direct Yellow 43. The first change noticeable is a slight greening of the vat dye. On further exposure, which need not be unduly prolonged, no more change is noticed in the vat dye, but the direct dye first loses depth, and then becomes redder, so that it is definitely the inferior dye. Thus, although the fastness of dyes is usually taken by the first perceptible change, this would give, in this instance, a completely wrong comparison.

A factor which seems to have been overlooked in

assessing fastness to light of dyed fabrics according to Khera and Kapoor (*72*) is the presence of small quantities of soap in the fabric. The soap may be present either as such, due to incomplete rinsing out after washing, or as insoluble calcium or magnesium soap due to the use of hard water. Dyed fabrics, containing soap traces, exposed to sunlight for 50 hours showed a marked change in shade. The ones with only water on them were unchanged. Khera and Kapoor suggested that the fading was initiated by breakdown of unsaturated soap molecules.

Smith (*119*) described the effect of one dye on another when exposure is made under moist wet conditions with combinations of certain direct dyes. He showed that dyes such as Durazol Yellow GS and GRS type, fast by themselves, when used in combination with other fast dyes, such as Durazol Blue 2GNS or Durazol Violet 2BS to produce green shades, fade. However, when the yellows are combined with Durazol Flavine RS the combination is fast.

Sen and Sharma (*115*) made solubility and lightfastness studies of azo dyes. Their results showed that the introduction of chlorine and tertiary butyl decrease, and alkoxy groups increase stability to light.

An investigation into the factors which cause changes in the lightfastness of direct dyes when dyeings are after-treated with urea-formaldehyde resins was made in 1954 (*4*), and revealed that careful selection of catalyst and control of the molar ratio of urea to formaldehyde could materially modify the degradative effect of the resin on those dyes which are impaired.

Giles (*60*) made a statistical examination of 16,000 published commercial lightfastness assessments. He formulated the following rules applying to most dyes and fibers:

a) On different fibers the fastness of a dye is higher, the higher the moisture regain of the fiber, provided that this is greater than about 4% (ie, the value of nylon). Thus, dyes are usually faster to light on viscose rayon than on cotton, on cotton than on nylon, on wool than on silk, and on secondary cellulose acetate than on cellulose triacetate or nylon. The above rule is reversed with fibers having a regain below about 4%, ie, with the newer synthetic fibers. With these the fastness is usually higher on the fiber of lower regain.

b) Fastness is often reduced by solid foreign material in the fiber, such as dulling agents or the resin used in crease-resistant finishes, or cationic surface-active agents or powerful hydrogen bonding compounds such as phenols or urea.

c) The increase in lightfastness with increase in depth of any dye is usually greater the higher the moisture regain of the fiber.

Dhar (*47*) found that the greater the molecular weight of a dye, the more stable it is to light. He also claimed that natural dyes contain more oxygen than artificial basic dyes and, therefore, resist photo-oxidation. On the other hand, Stromberg (*121*), commenting on light damage to old dyed fabrics predating 1850 when synthetic dyes were first discovered, said that usually the "natural" dyes showed less than satisfactory lightfastness by modern standards.

V. PHOTOSENSITIZATION BY TEXTILE FINISHES

Since so many materials act as sensitizing substances, it is the second type of action listed above (under Part II), photosensitization, which is particularly important in the textile field. The degradation of fabric by light is usually a matter of tendering or fading. It should be noted that a few authors describe it all as a fading effect and use the terms fading of strength, and fading of color. In this paper, however, tendering will refer to loss or change in strength and fading to loss of color. There is some contradiction in the literature about the sensitizing properties of certain compounds. Papers can be cited which claim sensitizing action for a compound and others which state that it provides protection for cellulose from sunlight. Wicks (*128*) has mentioned this double action of some sensitizers and emphasized the importance of considering complete systems rather than just the individual compounds used.

DYES ACCELERATE DEGRADATION———Dyes are the most frequently mentioned finishing agents that accelerate degradation of cotton in the presence of light. Vat dyes have received the most attention. Because of their lightfastness, they are often used on goods intended for outdoor use. With respect to the vat dyes, it can be generalized that the red, brown, orange, and yellow colors have the greatest sensitizing effects. Some vat dyes may actually retard the degradation of cotton, but the extent of this effect is quite small. Many investigators have studied a wide variety of dyes under various conditions in efforts to learn more about the relationship of dye structure and photosensitization.

Landolt (*78*) studied the tendering activity of 38 vat dyes by various tests, and made an attempt to discover from the constitutions of the dyes which substituents are responsible for tendering or nontendering properties. He concluded that most of the anthraquinone carbazole dyes tested were nontendering. In other groups certain substituents appear to exert a tendering influence and others a protective action. The simpler chemical compounds of the vat dye series have an inherent tendering action repressed or enhanced by the nature and orientation of the substituents and the resulting configuration. A difficulty in estimating the relation of constitution to tendering is the impossibility of comparing dyes of different light absorption, since the light energy depends on the wavelength. He also found that both oxidation and reduction phenomenon can be brought about by radiating cotton dyed with vat dyes. These results confirmed earlier suggestions that the tendering reaction was caused by a succession of reducing and oxidizing processes.

Bayley (*24*) reported that certain vat dyes tender cellulose, and this is true to a still greater extent when the dyed fabric is exposed to hypochlorite bleaching.

Nabar, Kothari, Scholefield, Turner, and Joshi demonstrated in a series of papers (*75, 93, 94, 95*) the remarkable property of certain vat dyes to accelerate the oxidation of cellulose by oxidizing agents and also by the action of light, supporting the earlier theory of Scholefield and Turner (*112*) that active vat dyes absorbed light of appropriate wavelength and were, in turn, reduced to their leuco compounds. During the reoxidation of the leuco compound by air an increased amount of tendering takes place. Nabar measured reduction potentials of vat dyes upon the fiber and their influence on the acceleration of the rate of oxidation of the cellulose by dilute sodium hypochlorite to produce oxycelluloses. The relation between the amount of oxygen consumed by the leuco dyeing from hypochlorite solutions and the difference between the potential values was found to be a straight line showing the amount of oxygen transfer bearing a direct relationship to the difference in the reduction potential values. Similarly dyed samples were exposed for varying periods to the

arc of the Fade-Ometer (35°C, 56% rh). It was found that the oxycelluloses obtained by light action showed identical behavior to that shown by the leuco vat accelerated oxycelluloses.

Desai and Vaidya (*46*) mixed various concentrations of dyes and hydrogen peroxide and exposed them to sunlight on clear days from January to March. They measured the change in each exposed solution with a colorimeter against the corresponding unexposed solutions, kept in the dark. Hydrogen peroxide was determined iodometrically. The peroxide decomposition was found to be directly proportional to its initial concentration and to the time, and inversely proportional to the initial concentration of the dye. The power of the dye to inhibit hydrogen peroxide decomposition decreases, in the order: basic dyes, chrysoidine, aminobenzene, naphthol yellow, picric acid.

Egerton (*48*) showed that the presence of certain vat dyes, even when they did not touch the cellulosic material, could accelerate degradation when subjected to radiation in a moist atmosphere. This held true over the distance studied of 0.3-8.0 mm. He ascribed this to formation of hydrogen peroxide as a volatile oxidizing agent. The same effect was observed when cotton pigmented with zinc oxide or titanium dioxide (probably anatase) was near untreated cotton.

Fox (*56*) studied 117 vat dyes and arranged them in five chemical classes which are subdivided into groups of closely similar constitution and properties. He proposed a simple test for determination of the tendering powers of vat dyes on cellulose on exposure to light. He examined a large number of dyes by a silver staining technique and related tendering directly to the constitution of many dyes. On the basis of this test, 34 yellow and orange vat dyes (mostly of known composition) were arranged in order of tendering activity. The dyes examined varied widely constitutionally, but it is clearly indicated that the commercial vat dyes from the anthraquinone-thiazole, diphthaloylstilbene, and anthraquinone-thioxanthren groups represent the worst types of vat dye from the viewpoint of tendering. Other active dyes come from the commercial anthraquinonylaminotriazines and the pyranthrone group. Commerical dyes from the anthraquinone-carbazole and acylaminoanthraquinone groups are found in both active and inactive classes, whereas dyes from the commercial flavanthrone and anthraquinone acridone groups are either inactive or protective. Fox also related lightfastness and tendering.

Tendering	*Average Lightfastness**
Highly active	4
Active dyes	5+
Moderately active dyes	6+
Mildly active dyes	6+
Inactive dyes	6 to 7
Protective dyes	7+

*Fastness tests and standards are those of Society of Dyers and Colorists. *J Soc Dyers Col 64*, 134-7 (1948).

Moran and Stonehill (*92*) studied the ultraviolet and visible absorption spectra of 39 vat "anthraquinoid" dyes and related quinones. Although they found no simple relation between spectra and tendering or fading, weak absorption bands, attributed to single-triplet transitions were exhibited by most active but not by any inactive dyes.

Sadov and Artemora (*107*) worked with insoluble azo dyes and studied their effect on the destructive action of sunlight and atmospheric exposure on cotton threads. All of the dyes studied increased the degradation of the cellulose in varying degrees. They reported the degradation as originating in the dyeing process; the addition of a reducing agent (formalin) to dyebath, along with thorough washing after dyeing, was recommended to decrease loss in fiber strength. The degree of decomposition was established from changes in strength, viscosity of a cuprammonium solution, copper number, and solubility in sodium hydroxide solution. After 30 days' exposure, strength had fallen to 73% of the initial value and the copper number had risen to 0.4 from zero.

Bamford and Dewar (*19*) stated that the more homogeneous the dyeings, the more activity as a sensitizer. This agrees with Wicks' (*128*) statement of increased activity of activating material in intimate contact with the fibers.

OTHER FINISHING AGENTS THAT ACCELERATE DEGRADATION——Copper is a sensitizer, but there is considerable evidence that the effect can be reversed depending on the quantity used. Simigin (*116*) mentioned the use of copper sulfate (10% solution) in the presence of an alkaline humin and acetic acid to protect cotton against light, microorganisms, and weather. The present authors have found that about 0.1% copper on cotton fabric (as copper acetate) has little or no degradative effect on weathering, whereas higher amounts degrade the fabric. Six months' weathering of fabrics treated with an alkyd resin containing copper acetate gave 34% breaking strength retention for a fabric containing 0.42% copper, and 38% breaking strength retention for a fabric with 0.35% copper, and 55-56% breaking strength retention for two samples with less than 0.1% copper content. The test controls retained less than 50% strength during the same period. Using Simigin's finish of 1% copper sulfate bath, followed by a humin bath, and this followed by a 1% acetic acid bath gave effective protection, 68% retention, while analysis showed around 0.3-0.4% copper present.

Rubin, Calvert, Rankin, and MacNevin (*105*) made a quantitative study of the heterogeneous reaction leading to hydrogen peroxide formation at light-activated ZnO surfaces in contact with oxygen and pure water. Reactions are given for the above and also when K_2CrO_4 additive is present. In general in the additive containing system the light-activated ZnO catalyzes the occurence of a normally exothermic reaction.

Kleinert and Mossmer (*74*) exposed samples of cotton, bright rayon, and dull rayon to over 300 hours of sunshine and observed serious losses in dry and wet tensile strength and in degree of polymerization. The strength loss for this time was in the range of 25-70% for normal fibers, but was increased to 53-80% by treatments that introduce trace amounts of copper or chromium. Exposure experiments using a quartz lamp on the same three fabrics showed that traces of H_2SO_4 and traces of sodium perborate also exhibited a similar effect on accelerating photodegradation.

Egerton (*49*) pointed out that the presence of small amounts of copper salts (0.004-0.1% Cu) will prevent peroxide formation, whereas larger amounts of copper will actually degrade the fabric.

In general, copper and manganese promote oxidation. Cobalt, lead, and manganese driers are used to promote oxidation and drying of paint films. Wicks (*128*) emphasized that caution must always be used in interpreting results. The effect of metals upon photochemical oxidation is fairly general. This effect can frequently be overcome by addition of a chelating agent such as salicylanil-ethylene diamine or ethylene diamine tetraacetic acid. Generally these act not as true antioxidants but by effectively removing the oxidants, since the chelation process ties up the metal by formation of rings.

While not truly a sensitizer, titanium dioxide (*11, 12, 65, 68*) is an example of a pigment which does absorb ultraviolet light and makes the energy available to the system as a whole. The energy permits an oxidation-reduction reaction to take place, the organic substance being oxidized and the titanium dioxide being reduced. Since atmospheric oxygen is present, however, the reduced titanium dioxide is reoxidized almost immediately. This reoxidized material is not as stable as the original pigment and is, therefore, more easily affected by light.

VI. PREVENTION OF DAMAGE CAUSED BY LIGHT

In the absence of oxygen the degradation of cellulosic fabrics by light is negligible. However, in atmospheres containing oxygen, degradation can be increased considerably with the presence of moisture. Egerton (*49*), studying the photosensitization of cotton, pointed out that the initial process responsible for the production of effects, such as the tendering of the fabric, fading of the dye, formation of hydrogen peroxide in the presence of water, is the absorption of light by a sensitizer. As a result of this absorption of energy one of the sensitizer's electrons is raised to a higher energy level. Once this happens one of the following processes may occur:

a) The energy may be rapidly degraded to heat, returning the sensitizer to the normal state with no damage done to the fabric.
b) The energy may be dissipated in fluorescence. Again no damage is done.
c) Collision may take place and energy transferred to another molecule.
d) The excited molecule may enter into a chemical reaction with another molecule, thus transferring energy with the result that the sensitizer may become either oxidized or reduced.

Activated sensitizer + oxygen ⟶ sensitizer + activated oxygen.

Activated oxygen + water ⟶ hydrogen peroxide + possible oxidation of the fabric.

In order to protect fabrics, means must be provided either to remove photosensitizers from the fabric or to add other materials to deactivate any photosensitizers present. This can be accomplished by the use of materials which act as screeners, light scatterers, or materials which utilize the solar energy themselves.

A screen is an optical filter that absorbs certain wavelengths of light and allows the rest of the spectrum to pass through. Coleman and Peacock (*40*) pointed out that a screen which absorbs ultraviolet light might well be colorless. Any screen, however, that removes both ultraviolet and a portion of the visible spectrum must necessarily be colored, a fact that is usually undesirable. As an example, the amber-colored screens currently used in show windows to protect from light modify the appearance of objects behind them. Colorless ultraviolet absorbing screens, on the other hand, can offer protection against ultraviolet light, but none against visible light. They also can be very useful in separating the effects of visible and ultraviolet light on substances. Coleman and Peacock made a study of the fading of dyes and the weakening of fabrics behind an ultraviolet absorbing screen of impregnated cellulose acetate. The film absorbed strongly in the ultraviolet region and transmitted highly in the visible region. For most of the fugitive dyes, the ultraviolet screen has very little effect. These dyes are faded much more by the visible portion of sunlight than the ultraviolet. There are two dyes that are only slightly affected by visible light, but extremely sensitive to ultraviolet light. They are CI Direct Yellow 6 and CI Direct Yellow 11. Coleman and Peacock sum up that, in general, the lightfastness of dyeings fugitive to visible light cannot be greatly improved by screening out the ultraviolet radiation. These results agree with those published by McLaren (*86*), even though he used a screen that absorbed appreciably more visible light.

Gantz and Sumner (*59*) stated that an ultraviolet screener for fabric use must be fast to washing, rubbing, or drycleaning. The ortho-hydroxy group which is considered essential to performance for the benzophenone type of absorber also has the property of making the compound soluble in alkaline solution. Gantz and Sumner report use of a plastic cover containing an absorber over untreated fabric which effectively screened out all radiation below 400 mμ. Unprotected cotton exposed thirty days had a breaking strength retention value of 77%. Using the filter, the breaking strength retained was 100%. Two months' exposure showed 72% breaking strength retention (no filter) and 77% retention with a filter. It would be interesting to know the results for six months or a year. The present authors have found that trends for only 30 days or even 90 days are sometimes reversed over longer periods.

The intensity of light scattered by molecules or particles of molecular dispersions should be inversely proportional to the fourth power of the wavelength of the light. Thus, Lord Rayleigh in his historic paper (*122*) explains the blue in the sky, due to scattering of sunlight by the atmosphere, since blue light has a shorter wavelength than red. This will not, however, explain scattering from large molecules and colloidal particles. Atherton (*16*) and Ashton and Probert (*15*), writing about colloidal particles, suggest that light scattered from a particle of finite size is in general reduced from the value predicted by calculations as a result of interference effects.

In the discussion below on the use of additives to protect cotton, consideration must be given to the form and quantity of additive applied, method of application, and the actual amount of additive remaining on the fabric. Many materials which have good protective value leach off on exposure. Proper means to hold the additive on the fabric mechanically must sometimes be supplied.

PURIFICATION OF THE CELLULOSE——Cellulose contains impurities and many of these can and do act as sensitizers. Scouring of the fabric helps remove these impurities. Reeves, Robinson, Brysson, and Berard (*103*) pointed out the advantages of different scoured fabrics over the unscoured in weathering tests. Rochas and Pierret (*104*), in their work with silk, found scouring removed impurities which when present acted as sensitizers to actinic degradation.

Goldthwait and Robinson (*61*) gave data showing comparative resistance of mercerized and unmercerized cotton to light and weather. There was less deterioration by the mercerized cotton, as measured by breaking strength, than by the unmercerized. At six months, ordinary mercerized cotton fabric had lost 17%. Half strength loss was reached for the control fabric at 9½ months' exposure and for the mercerized at 13½ months.

Bayley (*25*) claimed that the presence of pectins was beneficial as it decreased leaching of copper from added fungicides.

CHEMICAL MODIFICATION OF THE CELLULOSE———Modification of the substrate, the fabric itself, is a possible means of defense against light degradation.

Polyacrylonitrile has been of interest in this field (7). Burland and Taylor (37) experimented with polyacrylonitrile powder. It was radiated with x-rays in nitrogen. The net initial effect was crosslinking. With oxygen present, only main-chain breakage was noted at first. As radiation proceeded, the availability of oxygen to the polymer decreased and crosslinking occurred concurrently. Gottlieb (6, 8) of the Textile Research Institute reports that he deposited from an aqueous solution and polymerized acrylonitrile within the cellulose fibers. Material for tobacco shade cloth was treated without difficulty, and the resulting fabric was found to have excellent rot resistance and good physical properties. This fabric (4% nitrogen level) was exposed as a top shade cloth for one season on a farm in Connecticut and gave good indication that the treatment increased the stability of the cotton to light exposure. It was suggested that lead chromate be applied as an aftertreatment to increase light resistance. Wicks (128) has pointed out that the strong electronegative properties of the cyano group are reflected in the light stability of polyacrylonitrile.

Haydel, Janssen, Seal, Vix, and Gastrock (62) concluded from their data that polyacrylonitrile coating did not appreciably alter the behavior of cotton to heat or light.

Berard, Gremillion, and Goldthwait (26) reported that cotton has been made unusually resistant to degradation by weather by first dyeing it with certain light stable vat dyes and following this with partial acetylation. Vat dyeing alone or partial acetylation alone do not make cotton significantly more resistant to deterioration by sunlight than undyed fabrics, except for a few colors which do have a protective effect. Acetylated cotton is quite resistant to radiant heat. However, when these two processes are combined, excellent resistance to solar radiation is obtained. Berard and coworkers estimated that the combination of vat dyeing with lightfastness colors and acetylating may more than double the outdoor service life of cotton fabrics.

Carbamoylethylation of cotton fabric was accomplished by Frick, Reeves, and Guthrie (57) by impregnating fabric with an aqueous solution containing acrylamide and sodium hydroxide, and heating to dry the fabric. The fabric contained carbamoylethyl groups which were stable to hydrolysis under standard laundering conditions. The modified fabric was resistant to radiant heat.

ANTIOXIDANTS———Since the light damage to cotton is mainly a matter of oxidation, the use of antioxidants has been of interest. Most true antioxidants are phenols or aromatic amines and apparently function by a free radical mechanism. Wicks (128) described the action of antioxidants as a reaction with other substances producing less active free radicals with much lower energy content. Bogaty (28) and Bogaty, Campbell, and Appel (29) mentioned the antioxidants, pyrogallol, hydroquinone, and 1-naphthol, as decreasing the rate of deterioration of cotton fabrics exposed to tropical weather. Salvin and Walker's (108) work on service fading of disperse dyestuffs by chemical agents other than the oxides of nitrogen states that antioxidants sometimes prevent fading.

NONMETALS———Nickerson (96) describes a colloidal silica dispersion marketed as Syton and its uses as a textile finishing agent. The present authors have used this material on eighty square print cloth, both full strength and one to one dilution with water, exposed to outdoor weathering. The samples tested retained 70% to 75% breaking strength after six months' outdoor weathering compared with 50% for the weathered control. Persoz (99) studied the light reflection characteristics of coatings containing small spherical glass beads and concluded they gave good protection against light. Karyakin (69) reports that fading of dyes adsorbed on microporous glass, which is considered to be a form of silica gel, was caused by a reducing action of hydrogen from water under the influence of light. This was proved by the color being repeatedly restored by admission of oxygen after every reduction under the influence of light.

METALS———Heyl and Kramer (64) showed that an untreated cloth reflected 45% incident light (UV 3000-4000 A), absorbed 54%, and transmitted 1%. Their treated or metallized cloth, with a metal layer, reflected 45%, the metal layer absorbed 49.5%, the main body of the fabric received only 5.4%, and only 0.1% was transmitted. The metals they used were silver, and an aluminum bronze. They listed many uses and stated that a metallized fabric also protects against heat radiation and radiation from hot bodies. Their heat tests covered the light range 10,000 to 25,000 A. They suggest the protective action is both scattering and using up solar energy.

Perti, Ranganathan, and Subramanian (100) showed that aluminum salts have a slight protective action on cotton fabric. Sippel (117) reported that small amounts of iron in fibers will increase degradation by light. This degradative effect can be counteracted by the presence of phosphoric acid. Perti and coworkers showed that iron gave some protective action on cotton cloth exposed 100 days but not to any useful extent. In their work the metals were deposited as salts and then the fabric was given an alkaline bath. An iron pigment, known commercially as Midas Gold, was described by Lynch (84) as a colloidal solution of an iron organic complex. The present authors have used this pigment for treating cotton print cloth. Ten percent of the commerical liquid which contains 30% pigment was dispersed in alkyd resin and applied to the fabric. Breaking strengths retained at the end of six months were 80%, and after two years, 55%. The untreated controls were 50% at six months and the fabric was completely disintegrated in ten months.

Heffner (63) states that yellow iron oxide, lamp black, calcium carbonate, and antimony oxide in a chlorinated paraffin vehicle act as a light screen for fabrics against the degradative effect of ultraviolet light.

Sippel (117) suggested the presence of manganese salts to counteract the destructive action of titanium oxide. This probably was the anatase form of titanium oxide which is highly destructive. Perti, Ranganathan, and Subramanian (100) showed results on cotton fabrics exposed to sunlight for 100 days with breaking strengths taken every 17 days. They showed that manganese oxide (0.56 to 1.3% Mn) retarded actinic degradation markedly. Egerton (49) said that the presence of manganese salts prevents the formation of hydrogen peroxide and therefore decreases the degradation of cellulosic fabric.

Lang, Treiber, and Mader (79) stated that one of the

most important causes of actinic degradation of textile fibers at high radiation intensities is the presence of defects in the molecular structure. Thus, the photosensitizing (catalytic) effect of titanium dioxide, which accelerates the actinic degradation not only of delustered rayon fibers but also of paint coatings, is attributable to a stoichiometric oxygen deficiency in the crystal lattice. Under the influence of radiant energy, the imperfect titanium dioxide, represented by the formula $TiO_{1.9}$, transforms into Ti_2O_3 and liberates active oxygen which attacks oxidizable substances such as hydrocellulose. The activity of titanium dioxide pigments can be determined colorimetrically by exposing them to ultraviolet rays from a mercury-vapor or Xenon lamp in the presence of a dyestuff (leucocrystal violet) and following the color change. The test can be made quantitative by calibration with two pigments of known catalytic activity. By allowing titanium dioxide to adsorb certain metal hydroxides, its photocatalytic activity can be reduced.

Hindson and Kelly (*65*) made one-year exposure tests of cotton duck treated with several white pigments. Zinc chloride and lithopones caused slight decrease in strength over the 25% decrease found for untreated duck. White lead and antimony oxide had no effect. Anatase TiO caused a 90% loss of strength of treated fabric, whereas fabric treated with the rutile form of titanium showed only 3% loss in strength.

Rubin, Calvert, Rankin, and MacNevin (*103*) made a quantitative study of the heterogeneous reaction leading to hydrogen peroxide formation at light-activated ZnO surfaces in contact with oxygen and pure water. Reactions were given for the above and also when K_2CrO_4 additive is present. In general, in the additive-containing system the light-activated ZnO catalyzes the occurrence of a normally exothermic reaction.

Bayley (*25*), discussing fungicides of copper, added that many of them also give good protection from actinic breakdown. Of the organo-copper fungicides, copper naphthenate did not appear to increase breakdown of the fabric at low concentrations, but it did undergo hydrolysis with some loss of fungicidal efficiency. Copper 8-hydroxyquinolinate, a potent fungicide, was found to exhibit protection against actinic breakdown. Bayley added that the content of noncellulosic material in the fiber to which copper fungicides are applied helps prevent leaching of the copper during weathering, and this was attributed to the metal-binding capacity of certain of these noncellulosic materials; for example, the pectins. The use of soft petroleum wax leads to greater breakdown on weathering and this effect seems to be related to the presence of noncellulosic material on the fiber. The effect was not noted by Bayley in the presence of pigments, presumably due to their light screening power. The present authors have found that copper-8-quinolinolate has a slight degrading effect on cotton in the presence of light, although it does protect from microorganisms.

Some metals both protect and damage fabrics, depending upon the amount used and other materials present, as noted above. Wicks (*128*) cited copper and zinc as pro-oxidants and said the effect of metals can frequently be overcome by the addition of a "chelating agent" such as salicylanyl ethylene diamine or ethylene diamine tetracetic acid. These chelating agents tie up the metal ions by forming rings.

OXIDES AND HYDROXIDES OF METALS——Wright, Esteve, and Mack (*130*) screened many oxides and salts of metallic elements as finishes which might improve certain of the functional properties of cotton. Among the properties studied was outdoor weathering, one to three-month periods, actinic breakdown in the Fade-Ometer, 53°C for 100, 200, and 400 hours, and heat degradation, 140°C oven for 120 hours. In their breaking strength tests they found greater correlation between outdoor weathering and heat degradation than between weathering and the Fade-Ometer. They considered beryllium oxide, cobaltous hydroxide, and metaborate to have very good resistance to outdoor weathering, and manganous oxide and phosphate and nickelous phosphate to show some improvements.

One to three months is an extremely short weathering period. The present authors frequently have found cases where two to three months trends are completely reversed by six months or longer. Also, as has been pointed out earlier, only a small segment of the year's weathering is represented in a three-month period. Three summer months would give entirely different results than three winter months. Since correlation between outdoor weathering and heat degradation was obtained in the above work, it is most likely that summer months were covered in the outdoor weathering.

The present authors (unpublished data) found cobalt oxide (approximately 2.0% on the fabric) treated fabric to retain 96% of its strength after six months' outdoor exposure; nickel oxide (0.40% Ni on fabric) retained 92%; and manganese oxide 88% after six months, while the control was 50%. The same materials exposed outdoors, but glass covered for six months, had strength retention values as follows: cobalt 87%, nickel 80%, and manganese 95%. Also, fabrics treated with lead hydroxide (1.5% lead on the fabric) and silver oxide (2.4% silver on the fabric) exposed six months under glass had strength retentions as follows: lead 81%, and silver 74%, while the control was 71%.

PIGMENTS——The suitability of a pigment, either organic or inorganic, depends on several factors, such as particle size, degree of dispersion, electrical charge, specific gravity, hardness, crystal structure, purity, and solubility.

Kass (*70*) pointed out the importance of insolubility as a property for a pigment; almost complete insolubility in water is needed. A further valuable property is insolubility in the solvents normally used in drycleaning. He also listed good resistance to alkali, acids, chlorine, perspiration, peroxide, and gas fumes as desirable properties. Pigments generally meet these requirements because of their inherent insolubility. It is frequently necessary to bind pigments with a resin, although in many cases it is possible to deposit them *in situ* from solution. It is necessary, of course, that the resin binder also be insoluble. Milling to obtain the proper dispersion of a pigment is carried on in the presence of an emulsifier or a dispersing agent. Overmilling can cause destruction of some of the primary particles, ie, the smallest aggregates which are still crystallite units (0.01-0.5μ), and hence loss of brilliance and dulling of color. Baker and Virtue (*18*) in their study of pigment milling found that for a given paint formulation the covering power was governed to a large degree by the milling time, due to the fact that milling breaks down and disperses the pigment agglomerates, and that a dispersion of fine particles offers more resistance to the transmittance of light than a dispersion of larger ones. Usually there is no direct affinity between the fiber and the pigment. The resins in which the pigments are often incorporated form the link between pigment and fiber.

Tompkins and Tompkins (*125*) applied the theory of light scattering to the design of paint coatings for the reflection of infrared radiation. Commercial white pigments were unsuitable. In order to possess the minimum absorption or radiation, a pigment must be produced in as high a state of purity as possible and must have nearly perfect crystallites. It can be improved also by careful selection of particle size distribution. With rutile TiO_2 of larger particle size than usual, reflectivities of infrared radiation of 98% appeared possible. Silicon carbide and high-purity silicon are potentially outstanding in this application. Flasch (*54*) claimed a pigment for paint with excellent fastness to light and very good fastness to weathering by incorporating into CdS crystal lattices 0.2-1.0% selenium on the weight of the cadmium. Bube and Barton (*33*) recommended caution in the preparation of CdSe crystals because vacuum annealing of insulating and insensitive CdSe crystals grown from the vapor phase increased their photosensitivity to a value at least as high as that of crystals sensitized by impurity incorporation. Such annealing-sensitized crystals have 100 to 1000 times greater sensitivity than impurity-sensitized crystals at low light intensities.

Research recently reported from the Southern Regional Research Laboratory (*10, 31, 32*) described the protection provided cotton fabric by over one hundred pigments. The pigments were utilized in the study in two respects: a) print cloth and 10-oz duck were impregnated with a dispersion of the pigments in an alkyd resin, and b) duck fabric was coated with the pigments in an alkyd vehicle. After exposure to outdoor weather, the impregnated and coated fabrics were evaluated with respect to strength retained (breaking strength tests) and color retention (visual) of pigment. The results obtained with the impregnated fabrics were in agreement with those obtained from the coated fabrics. At least one pigment from each of the following groups protected the cotton to a large degree from sunlight degradation: white, extender, metallic, iron oxide, green, red, maroon, blue, black, yellow, orange, and a miscellaneous group of inorganic salts and oxides. Some of the most outstanding pigments in this respect were raw sienna,burnt sienna, chrome green, hydrated chrome oxide, parachlor red, chrome yellow, chrome orange, orange lake, dinitraniline orange, basic zinc chromate, molybdate orange, and red lead. A number of the pigment colors were found to be lightfast. In general, the pigments that were most lightfast to color provided the most strength protection for the cotton from sunlight.

Denninger (*45*) prepared three forms of lead stannate (artists' pigments used from 15th to 17th centuries) by different heat treatments. Each of these three pigments, together with Naples Yellow (lead antimonate) as a control, were exposed as paint films to sunlight under glass for 22 weeks. No fading of color was observed, not even after 100 hours' exposure to ultraviolet radiation.

POLYMERS——The most important types of resins suitable for the fixation of pigments are: a) phenol formaldehyde; b) urea formaldehyde; c) melamine formaldehyde; d) alkyds; e) vinyl, acrylic, and styrene resins; f) synthetic lattices; and g) polyurea and polyurethan resins. Such a resin is rarely used alone as a pigment-binding agent, but usually in combination with at least one other resin, and with such special ingredients as softeners, defoamers, and emulsifiers. The mechanical properties of resin films can be modified by the degree of polymerization, and it is of importance whether the polymerization reaction leads to oriented macromolecules or to unoriented straight chain, branched, or coiled macromolecules.

Kass (*70*) pointed out that it is linkage of single molecules of the resin former into macromolecules that produces a continuous film, which fixes the pigment to the substrate. These large molecules are formed by both addition and condensation reactions.

Present knowledge of the application of pigments and resins to textiles is based mostly on empirical experience. Sippel (*117, 118*) reported tests made of polyvinyl chloride and polyacrylonitriles, and he said that the polymer mixture on fabric provides good weathering properties.

Keane, Norris, and Stein (*71*) reported that crystalline polymers scatter visible light because of the refractive index differences between crystalline and amorphous portions. They suggested that a stretched polyethylene film will increase the scattering and protect against light. The intensity of the light scattered varies with the orientation of the film about the axis of the incident light beam.

Wicks (*127*) gave an excellent description of the properties of the alkyd resins and their possible use for textiles. Most alkyds provide little or no protection to cotton from sunlight.

Fitzgerald (*53*) studied the action of ultraviolet light of a Hanovia Utility Lamp on pigmented and unpigmented resin films in an oxygen atmosphere. He followed the reaction quantitatively, by measuring the CO_2 and CO evolved directly from the resin. This reaction occurs in an extremely thin surface layer which disappears as the reaction proceeds, and in the case of pigmented films produces chalking. In addition to the surface reaction, there is a bulk reaction that extends throughout the depth of the film which must be essentially a dehydration or dehydrogenation reaction, since the atomic ratio of hydrogen to carbon in the mixed gases was much higher than it was in the pure resin. Fitzgerald suppressed all wavelengths shorter than 3000 A and found the erosive surface reaction greatly suppressed, while the bulk reaction continued at a slightly slower rate.

Landolt (*77*) suggested a hydrophobic methylol melamine resin as improving the properties of fibers and dyeings. When applied to cellulose fibers, Landolt claimed it improved the following properties: antiswelling, wet strength, dimensional stability, resistance to water spotting, fastness to weathering, fastness to light and atmosphere of vat dyes, and fastness to chlorine of dyes. The hypothesis was suggested that the resin inside the fibers produces crosslinking of cellulose chains and so counteracts the tendency of the fiber to swell when in contact with water. Berard, Gautreaux, and Reeves (*27*) found fabric finished with an acid colloid of trimethylolmelamine to have excellent rot resistance and good light resistance.

The following factors (*1*) have been suggested as influencing the action of urea formaldehyde on lightfastness of dyes: a) molecular structure of the dye, b) chemical reaction between resin and dye, c) breakdown of resin by light with formation of product affecting the dye, d) molecular ratio of urea to formaldehyde, e) catalyst, and f) pH of resin-finished fabric. Urea formaldehyde and other N-methylol type finishing agents protect cotton from color degradation.

Bauer (*22*) showed transmission curves over the range 2700-4300 A for polyvinyl chloride, polymethylmethacrylate, polystyrene, benzyl-cellulose, nitrocellulose, cellulose triacetate, cellulose butyrate, and cellu-

loid. Some of these polymers are frequently used to coat cotton fabrics.

Meyer and Gearhart (*91*) found butyrate plastic to be an ultraviolet inhibitor for cellulose acetate. Perhaps the butyrate would provide some protection for unmodified cellulose.

Tamblyn and Armstrong (*123*) claimed, in an Eastman Kodak patent, that p-(o-chlorophenylazo)N,N-dimethylaniline protects plastics from degradation on exposure to ultraviolet light. Therefore, these materials should be considered when the plastics are used in coatings for cotton fabrics.

MISCELLANEOUS ORGANIC COMPOUNDS——A British patent (*9*) claimed the use of a series of 1:3:4-ox-diazole derivatives not only as fluorescent optical brightening agents, but for rendering textiles, wrapping papers, and foil more or less impermeable to ultraviolet rays. A recent paper (*3*) gave a long list of possible light screeners and a description of a scale for showing the relative effectiveness of sunscreens which was set up by W D Kulmer of the Univ of California. The absorbence of a 0.1% solution in a fused silica cell of 0.1 mm path length is determined in an ultraviolet spectrophotometer. Wavelength used was 3080 A. The "sunscreen index", which is the optical density of a 1% solution, was obtained by dividing percent absorbence by percent concentration. The paper listed indices of some commonly used compounds:

ethyl-p-dimethylaminobenzoate, 14.8;
ethyl-p-aminobenzonate, 9.6;
iso-butyl-p-aminobenzoate, 9.2;
propyl-p-aminobenzoate, 9.0;
n-butyl-p-aminobenzoate, 8.0;
beta-methyl umbelliferone, 7.7;
p-aminobenzoic acid, 7.4;
sodium p-aminosalicylate, 4.3;
digallol trioleate, 2.3;
dipropylene glycol salicylate, 1.9.

Schneider, Berg, and Mirous (*111*) described the light-protecting action of dialkylaminoalkyl p-methoxycinnamates and N-beta-dialkylaminoethyl-N-alkyl-p-methoxycinnamides against ultraviolet radiation. Best of those mentioned were N,N-diethylaminoethyl derivatives.

Gantz and Sumner (*59*) described the effectiveness of the substituted benzophenones as light screeners. They can be used in fabric coatings or finishes, applied to yarns or fabrics that are known to degrade in outdoor exposure because of ultraviolet light. These compounds can markedly improve the lightfastness properties of those dyes which are faded by ultraviolet light.

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ADR ABSTRACTS

Synthetic Fibers in Europe

Anon, *Chem & Eng News 38*, 96-106, 120, Dec 5, 1960

American companies have a big stake in Europe's synthetic fiber boom. In fact, American and European interests in this field are tied up so closely that it is hard to tell where one starts and the other ends.

American companies are exporting to Europe both synthetic fibers and the chemicals from which they are made. They are also manufacturing in Europe as well. At the same time, big European companies, eg, the Dutch AKU (through its subsidiary, American Enka) and British ICI (with Celanese), are producing in the U S. Market trends and new developments on one side of the Atlantic are being closely watched on the other.

Polyamides, polyesters and acrylics are the leading fully synthetic fibers in Europe, just as they are in the U S. Following are some of Europe's foremost producers:

AKU (Algemene Kunstzijde Unie, NV), with headquarters in the Netherlands, has 29 plants scattered through Europe, producing a variety of fibers, particularly nylon 6, as well as cellophane and synthetic rubbers.

Courtaulds (British) owns British Celanese and, with ICI, also owns British Nylon Spinners. The company also makes acrylic, protein and olefin fibers and is experimenting with nylon 6.

In Germany, Bayer has pioneered with nylon 6 and acrylic fibers (Dralon). Farbwerke Hoechst makes polyester fiber. BASF and Bayer are leading producers of caprolactam.

ICI (British) makes polyester fibers and nylon salt, and plans to make also nylon 6 and polypropylene fibers.

Montecatini (Italy) also makes polypropylene fibers, noted for their low sp gr, and polyvinyl chloride fibers (Movil).

Rhodiaceta (France) also makes PVC fibers, as well as nylon and polyesters, and is another large producer of caprolactam.

Snia Viscosa (Italy) produces viscose and acetate rayon, casein fiber, nylon 6 and nylon 11 (Rilsan).

Polyamides, the first fully synthetic fibers, are still in first place in Europe, but polyesters are growing and are at present ahead of acrylics in output (the reverse of the situation in the U S.

Production of noncellulosic fibers in the Communist countries is said to be far behind that in the West, but several contracts have now been signed between Western European producers and the USSR and its satellites for the construction of plants for synthetic fibers and their raw materials, including polyester, acrylic and cellulosic fibers and nylon 6.

Of the American firms who are starting to manufacture fibers in Europe, the Chemstrand Corp is already producing Acrilan in North Ireland, and Du Pont plans to make Orlon in the Netherlands in 1961.

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Arnel 60, a New, Stronger Triacetate Fiber

Clutz, C S, Elsom, H F and Williams, R D, Papers AATT, *Modern Textiles 41*, 71-5, Nov, 1960

Arnel (triacetate) has grown into an important market fiber, the authors state, particularly for dress and sportswear fabrics, in which it is used both alone and in combination with other fibers. The Arnel/cotton fabrics are characterized by ease of care and economical dyeing methods.

The triacetate fiber has affinity for the same dyes as secondary acetate, but to achieve maximum fastness characteristics under practical and economic processing conditions, new techniques have been developed for dyeing heavy or medium shades. These techniques include the use of selected dyes and dye accelerants, and higher temperatures than have been used with ordinary acetate.

Essentially Arnel 60 is the same as regular Arnel staple except for tensile properties and surface characteristics. Since the strength of Arnel 60 is nearly twice that of Arnel, appreciably finer count yarns may be spun. Arnel 60, like Arnel, permits the application of pleats and creases which are retained in end usage and laundering.

Arnel 60's relatively low sensitivity to damage in chlorine, peroxide and hypochlorite bleaches makes possible good retention of whites, particularly in the cotton blends. This is further assured by the fiber's good resistance to scorching.

The good elastic recovery of Arnel favors wrinkle resistance in properly constructed and finished fabrics.

Like Arnel, the 60 type is relatively insensitive to heat when it has been properly heat-set in finishing. The safe ironing temperature for 100% Arnel 60 fabrics is 450°F.

Since Arnel 60, like the older Arnel, has an affinity for only disperse dyes, combinations with cotton and rayon may be dyed in a wide range of shades by cross-dyeing.

Arnel 60 fibers are inherently dimensionally stable. Most fabrics may not only be drip-dried to obtain ease-of-care properties, but they may also be tumble-dried

while retaining their dimensional stability.

The natural appearance of the new fiber provides a semi-dull luster without the use of pigment, an advantage in staple applications.

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Tricel Helps Launderers (for Machine Clothing)

Brit Celanese Ltd, *Man-made Textiles 37, 51, Nov, 1960*

During the past five years, the laundry industry has seen a gradual changeover to man-made fibers from the traditional cotton and wool previously used for machine clothing.

The advantages of man-made fibers in sheetings and press cloths are widely known; they give long working life with freedom from discoloration due to charring. The higher price is more than compensated for by these advantages.

Tricel is one of the newest fibers available to laundries. Development work has been going on for the past two years, and now a complete range of fabrics is available for machine clothing. The fabrics are woven from a mixture of Tricel and polyester fiber. These fibers make a good combination; Tricel is resistant to moist heat and is not readily weakened by steam, while polyester fibers have good dry heat resistance coupled with excellent wearing properties.

Tricel has an added advantage over some man-made fibers used in calender and press cloths because of its increased water absorbency. This helps to prevent static electricity.

Rapid presses at one laundry, used for overalls, were covered with Tricel-polyester sheeting, which was given a trial for 18 weeks, being removed for washing every weekend. The sheeting was still in use at last reports. Another laundry obtained 15 weeks' service from a similar sheeting on polished head presses.

Tricel-polyester calender packing flannel has been found satisfactory when used either as a packing flannel or as a top calender cover. Its working life is said to be several times the life of wool flannels. At one laundry the Tricel-polyester flannel for top sheeting on calenders had been in service for 30 weeks, it was reported.

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Potassium Permanganate in Shrink Resist Processes for Wool

Somers, J A, *Textile Recorder 78, 68-70, Nov, 1960*

Some 15 years ago a new method for making wool unshrinkable by reducing its felting power was introduced, and in the intervening years this process has acquired considerable importance. It has been accepted as probably the most convenient and satisfactory method devised to date, according to the author.

The wool is treated with a cold, slightly alkaline liquor containing potassium permanganate ($KMnO_4$) and sodium hypochlorite. It was originally stated that neither product, used by itself, was capable of giving as satisfactory a result as their combination.

Recently, in Australia, research has shown that by using other conditions, much the same satisfactory result can be produced by the use of $KMnO_4$ without hypochlorite.

The disadvantage of $KMnO_4$ when used alone is that it causes excessive degradation of the wool. It is now found that if the wool treatment with $KMnO_4$ is carried out in cold to warm solutions containing at least 15% of common salt (enough to half-saturate the solution) and about 4% (calculated on the wool weight) of $KMnO_4$ under neutral or slightly acid conditions, then the wool can be made substantially unshrinkable without any appreciable degradation.

Removal of the brown deposit of MnO_2 from the wool, following the above treatment, is necessary not only to regain (or improve) the original whiteness of the wool but also to make it more resistant to shrinkage (the MnO_2 deposit is said to make the wool fibers rougher and so to increase their tendency to felt). Also, if sodium bisulfite is used to remove the MnO_2, it also reduces the wool and gives it further resistance to shrinkage, it is said.

The question arises as to how the common salt acts as a protective agent for the wool. The idea behind this appears to be that the presence of salt limits the oxidation of the wool to the surface layer of each fiber; it is only this surface layer that needs to be modified to give the wool shrink-resistance.

•

Preparation and Bleaching of Blends

Anon, *Dyer 124, 571, 573, Oct 7, 1960*

The control of bleaching of cotton fabrics has been given much consideration in the past, but the introduction of blends of cotton with the synthetic fibers has brought new problems, and in many cases has limited the use of certain bleaching compounds.

Blends of triacetate and cotton can be bleached with sodium chlorite, with the addition of 0.25% nitric acid and 0.2% tri-sodium polyphosphate. Under these conditions temperatures up to 92°C can be used, but bleaching should not be carried on beyond the minimum time required to obtain the desired white, usually 30-60 minutes. Hydrogen peroxide, with a nonionic detergent, and set with 0.75% caustic soda, may be used up to 80°C. There is less risk if the caustic soda is partly or fully replaced with disodium phosphate.

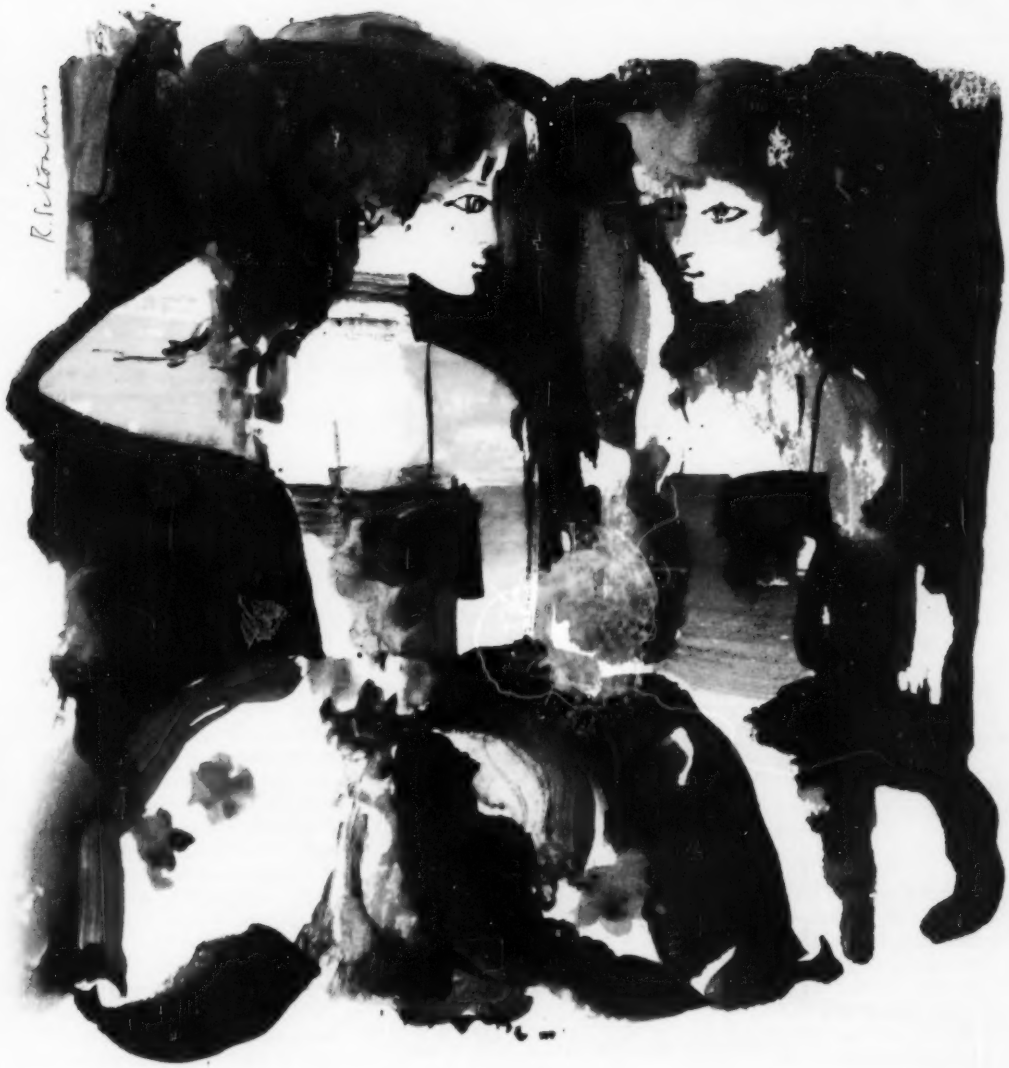
Fabrics made from acrylic/cotton blends may also be bleached with sodium chlorite, but setting with an organic acid such as 0.2% formic acid is recommended. Peracetic acid may be used in a 0.3% solution, set with 0.25% sulfuric acid and 0.1% hexametaphosphate.

Terylene/cotton blends present some problems, mainly due to the sensitivity of the polyester fiber to alkali. Hydrogen peroxide can be used at temperatures up to 90°C in a bath set with 0.3% sodium silicate and 0.05% caustic soda.

In bleaching nylon/cotton blends, peracetic acid, sodium chlorite and hydrogen peroxide have been commonly used. The hypochlorites are not recommended for nylon.

Similar methods can be used for fabrics made from blends of viscose staple with the above synthetics, but less severe methods may be used, since viscose does not contain the natural impurities present in cotton.

The main differences in scouring and bleaching all-cotton fabrics, and those made from blends of cotton or viscose staple with the various synthetic fibers concern the machines employed. Kier-boiling is fairly standard with cotton fabrics, whereas it is seldom employed in any form with the other fabrics. It is, however, practicable to use either batch or continuous methods of preparation and bleaching, particularly with the cotton blends, and also under controlled tension conditions with the viscose staple blends.



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PROCEEDINGS

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January 9, 1961 No. 1

1960 Convention———

SYMPOSIUM—DYEING AND FINISHING OF NEW CELLULOSIC FIBERS*

WALTER J HAMBURGER, *moderator*
Fabric Research Laboratories, Inc
Dedham, Mass

I. Dyeing and Finishing of Zantrel† Polynosic† Staple Fiber

C EUGENE COKE
Hartford Fibres Co
140 Madison Ave
New York 16, NY

A discussion of this fiber, the basic concepts of which led to its development, its structure, and physical properties are presented. Similarities between this new man-made cellulosic fiber and cotton are pointed out.

The paper offers a description of the classes of dyes and dyeing techniques which can be applied to this fiber. Also included are wet-processing procedures and the application of "easy-care" resins.

End uses and fabric performance characteristics are reviewed briefly.

INTRODUCTION

ZANTREL is a revolutionary new member of the family of cellulosic fibers which provides a combination of physical properties, performance characteristics and aesthetics hitherto unavailable to the textile industry. This fiber is the outcome of a vast amount of fundamental research work and adaptation to commercial production extending over a period of some 20 years. It vividly illustrates the great strides which have been made in recent years in our understanding of the very important role played by cellulose chain length and microfibrillar structure on fiber properties.

HISTORICAL———The pioneer in the development of Zantrel was the late Schozo Tachikawa, president of the independent Tachikawa Research Institute in Japan. His basic target was to produce a man-made fiber having the desirable properties of mercerized, combed cotton. Research work which commenced in 1938 was first described in the English-language literature in 1951 (*1*). The process developed by Tachikawa is radically new and will be discussed later in this paper. Certain features of his original process were not very practical for large-scale commercial production.

In 1953, the European group, Fabelta of Belgium, Comptoir des Textiles Artificiels et Synthetiques of France and CTA's Swiss affiliate, Viscose Suiss, acquired an option to produce the Tachikawa fiber, subject to satisfactory commercial development. Finally, in July of 1958, a license agreement was signed.

The role played by the European CTA group in the development of Zantrel was to modify Tachikawa's research laboratory technique to give a commercially feasible and practical process.

Hartford Fibres Company entered the picture in August of 1959, by acquiring a license to produce the fiber in the United States. Commercial production of Zantrel at Hartford commenced in mid-September of 1960.

Today, the method of manufacture of Zantrel is protected by seven U S patents.

GENERIC NAME———Because of the major difference in method of manufacture, physical properties, and performance characteristics of Zantrel staple, compared with the "old" rayon of commerce as it has been known to the textile industry for the past thirty years, Hartford Fibres Company made application to the FTC for a new generic name. This application was summarily denied, solely on the basis of chemical composition. Until pending litigation is resolved, to comply with the Textile Fibers Identification Act, the fiber is referred to as Zantrel Polynosic Rayon.

TECHNOLOGY OF MANUFACTURE———Involved in the manufacture of Zantrel is a radically new concept in cellulose chemistry. This concept is concerned with maintaining maximum cellulose chain length throughout the production of a very dilute cellulose zantrate solution. The concept also includes the formation

*Held October 6, 1960 at the Sheraton Hotel, Philadelphia, Pa. during the 1960 AATCC Convention

†Trademarks applied for by Hartford Fibres Co

of reconstituted cellulose in such a manner that the fiber has a stable and homogeneous microfibrillar structure. This structure is similar to that of the natural cellulosic fibers, such as cotton and flax, in which the cellulose molecules forming the structural elements or fibrils are closely and uniformly arranged with strong chemical bonds between them. This is in contrast with "old" rayon in which the fiber is built up from irregular bundles of cellulose molecules which are randomly arranged and which therefore have fewer and weaker chemical bonds. These differences in chain length and in structure are responsible for the differences in physical, chemical, and performance characteristics between Zantrel and the natural cellulosic fibers on one hand, and "old" rayon on the other hand. They account for the much lower resistance of "old" rayon toward swelling agents such as water and alkalis, which penetrate between its molecules readily and thereby further weaken the chemical bonds holding the structure together. This also accounts for the low wet strength and low initial wet modulus of "old" rayon.

To produce this new man-made cellulosic fiber, there is involved a new and unique manufacturing technique, including new chemical compositions, concentrations, and temperatures throughout the process. New chemical controls are involved and control limits are much narrower than ever employed in the manufacture of "old" rayon. A large portion of the equipment used to produce Zantrel has been especially designed and engineered for this fiber. Raw material for the manufacture of Zantrel is either cotton linters or wood pulp of the highest quality to meet rigid specifications for a high and uniform cellulose chain length (DP). The average DP of cellulose molecules in the Zantrel fiber is not less than 520, as compared with 240-280 for "old" rayon.

CHARACTERISTICS OF ZANTREL FIBER

STRUCTURAL —— When the structure of the Zantrel fiber is examined under the microscope (Figure 1), it will be observed that it has a round and homogeneous cross section, and that its structural elements consist of very fine, well-orientated microfibrils, all of which is unique to this fiber. Comparison of the structural elements of cotton, Zantrel, and "old" rayon (Figure 2) shows a remarkable similarity between cotton and Zantrel, and a pronounced dissimilarity between them and "old" rayon.

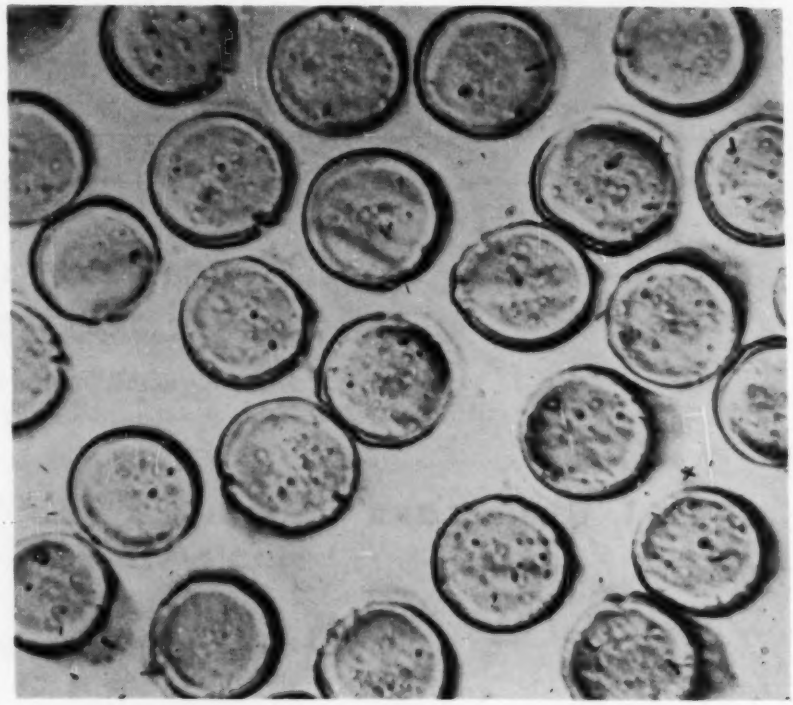

Figure 1
Photomicrograph showing cross section of Zantrel fiber. (600 X)

PHYSICAL——A summary of the major physical characteristics of Zantrel staple fiber is given in Table I. It is apparent from this Table that, while Zantrel fiber has very good physical properties in the conditioned state, its properties in the wet state are outstanding.

Figure 3 shows typical Instron stress-strain curves for the Zantrel fiber, in the conditioned and the wet state. These curves bear a striking resemblance to similar curves for cotton.

From Figure 3 and Table I, it is apparent that the initial wet modulus (% elongation under a load of 0.5 gpd) of Zantrel is equally as good as that of cotton and is vastly superior (2.5 vs 11.0) to that of "old" rayon. It is therefore to be expected that this type of fiber is sometimes referred to as a high wet modulus fiber.

The inherent dimensional stability of fabrics made from Zantrel is attributable to its high initial wet modulus, its relatively low swelling, and its excellent wet elastic recovery.

All tests involving the strength and elasticity characteristics of the fiber were performed on an Instron Tensile Tester, the tests specimens having a nominal free gauge length

TABLE I
Physical characteristics of Zantrel fiber

	Conditioned	*Wet*
Tenacity (gpd)	3.4	2.7
Elongation (%)	10	12
Tensile strength (psi)	66,000	52,000
Initial wet modulus (Elongation under a load of 0.5 gpd) (%)	—	2.5
Average stiffness (gpd)	34	22
Average toughness (g-cm/den/cm)	0.17	0.16
Repeated strain tests @ 3% (five cycles)		
% Permanent set	0.98	0.12
% Elastic recovery	67.2	96.1
Repeated strain tests @ 5% (five cycles)		
% Permanent set	2.07	0.47
% Elastic recovery	58.6	90.6
Specific gravity	1.51	—
Moisture regain (70°F, 65% RH)	12.2	—
Water swelling (70°F)		
By weight (g-water imbibition) (%)	—	60
Cross sectional area (%)	—	35

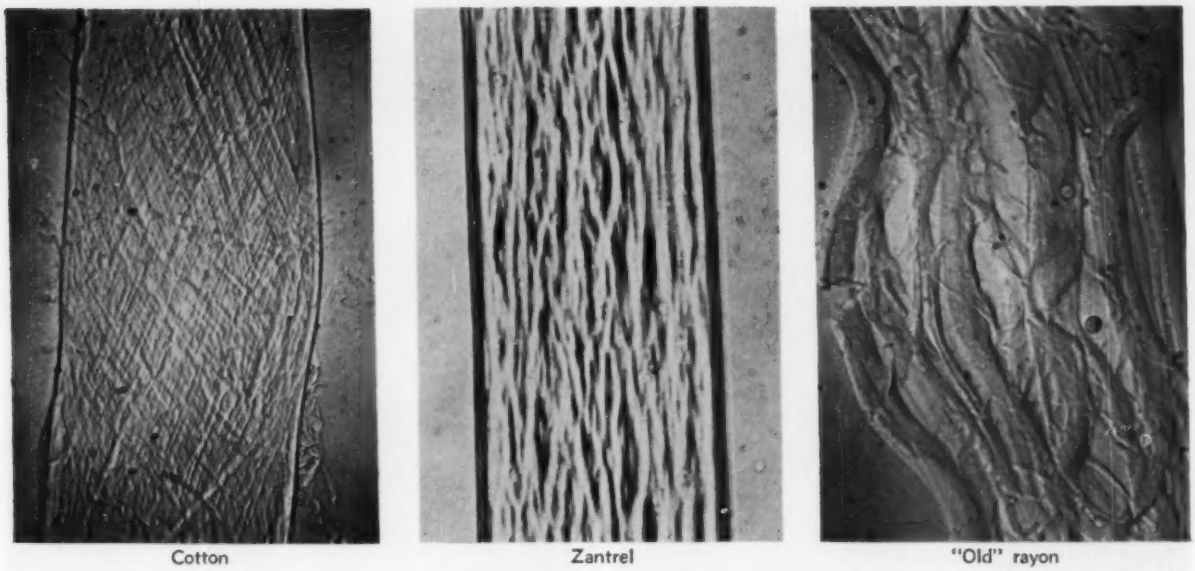

Figure 2
Photomicrographs showing the fibrillar structure of cotton and Zantrel, and nonfibrillar structure of "old" rayon. (600 X)

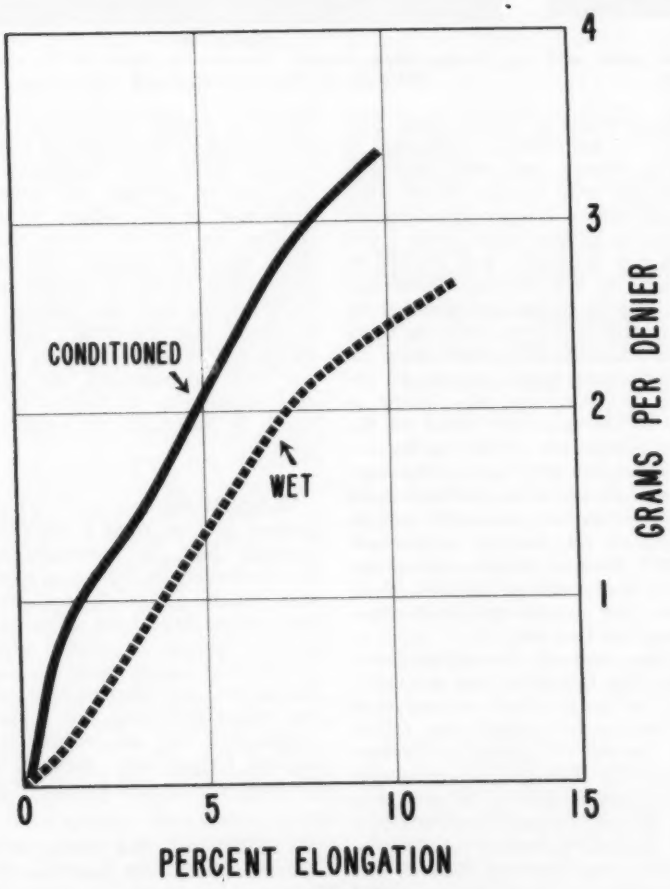

Figure 3
Typical Instron stress-strain curves for Zantrel

of one inch; jaw speed was 0.20 inches per minute; and the full scale load was 10 grams.

Two sets of ambient atmospheric conditions were utilized:

a) Conditioned-fibers were conditioned in an atmosphere of 70°F and 65% RH.

b) Wet-fibers were soaked in room temperature water for at least 45 minutes, and tests were performed under water.

Wherever possible, testing procedures were carried out in accordance with ASTM Standards for Textile Materials.

CHEMICAL——It has already been pointed out that the average chain length (DP) of cellulose molecules in Zantrel is about twice that of "old" rayon. Also, it has been mentioned and illustrated (Figure 2) that the structural elements or fibrils which form the Zantrel fiber are closely and uniformly arranged and bear a striking resemblance to cotton. It is these chemical and structural characteristics which account for the remarkable resistance to swelling agents such as caustic soda and water. From Table I, it can be seen that water of imbibition and cross sectional swelling of Zantrel are similar to mercerized cotton and about half that of "old" rayon. The striking difference in resistance to caustic soda between Zantrel and "old" rayon is illustrated in Figure 4. This resistance of Zantrel to chemical swelling agents permits

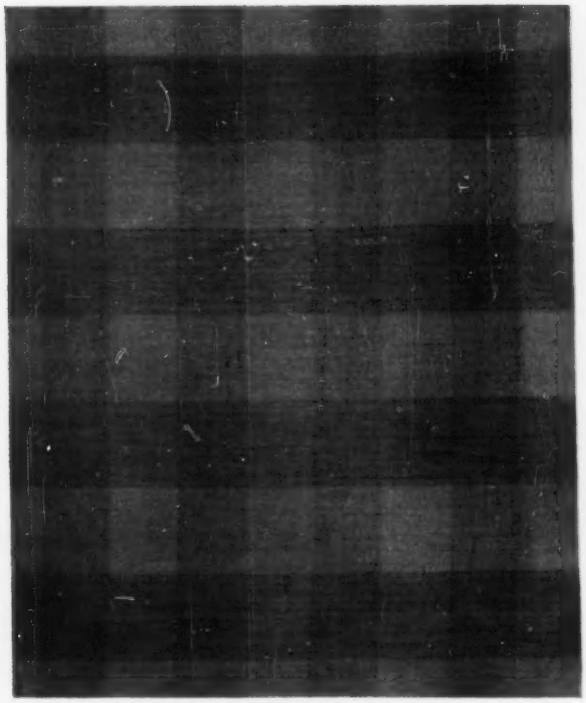

Figure 4a
Greige fabric containing bands of Zantrel (lighter color) and "old" rayon (darker color), untreated

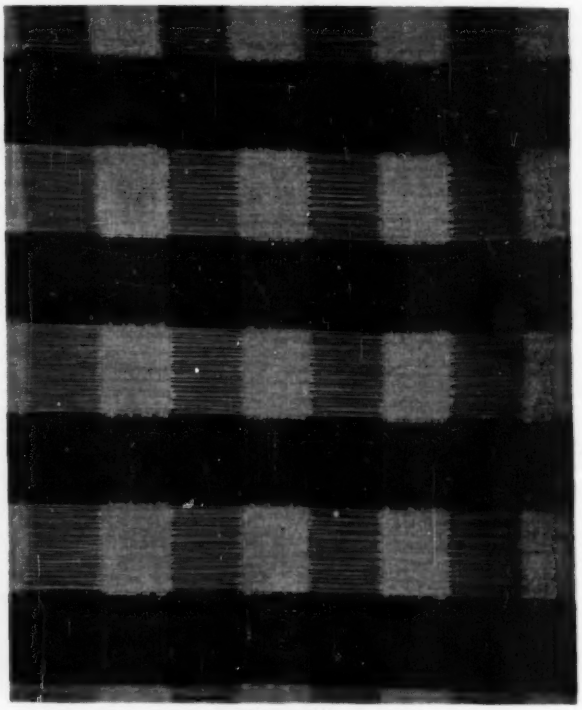

Figure 4b
Greige fabric, treated. Showing the effect of 8% sodium hydroxide at 0°C on Zantrel and "old" rayon

the wet processing and dyeing of Zantrel fabrics to be carried out on the continuous cotton system.

WET PROCESSING

GENERAL——100% Zantrel and Zantrel blend fabrics either as intimate blends or ortho mixtures (Zantrel warp, non-Zantrel filling, or vice versa) may follow one of two routes through wet processing. One is the so-called "synthetic" route and the other is the continuous cotton range. Of the two the latter is, of course, the more economical.

A typical "synthetic" route consists of the following routine steps: a) singe, b) desize, c) scour, d) bleach, e) dye, f) resin treat, g) wash, h) compressive shrink.

A typical continuous cotton range procedure consists of the following: a) singe, b) desize and scour, c) caustic saturate (if necessary), d) bleach, e) mercerize (if necessary), f) continuous vat dye, g) resin treat, h) wash, i) compressive shrink.

The above-mentioned steps are all conventional and it is not necessary to discuss them in detail. When Zantrel is used in intimate blends or in ortho mixtures with other fibers, some modifications of the procedure may be required to accommodate the other fiber or fibers.

The continuous cotton range procedure is particularly applicable to intimate blends and ortho mixtures of Zantrel with cotton. When 100% Zantrel fabrics are processed on the continuous cotton range, steps c and e are not necessary and should be omitted. In this process, desize and scour may be accomplished either by enzyme followed by scour or by using caustic followed by an acid sour. In Zantrel/cotton blends, it may be required to mercerize the fabric in order to increase the luster of the cotton component. This can be accomplished by either of the two conventional mercerizing methods used for cotton without excessive loss in strength of the Zantrel component. In 100% Zantrel fabrics, mercerization is not required because these fabrics have an inherent luster equal to mercerized cotton.

In the case of Zantrel/polyester blends, the fabric is best wet processed in the identical manner used for a similar cotton/polyester fabric.

The ability of Zantrel to process satisfactorily through the continuous cotton range is due to its resistance to the action of caustic soda which is vastly superior to that of "old" rayon. This difference between Zantrel and "old" rayon is visually demonstrated in Figure 4. The upper photograph shows a greige fabric consisting of alternating bands of Zantrel and "old" rayon, warp and fillingwise. As mounted on a frame, the fabric was immersed in 8% sodium hydroxide solution at 0°C for thirty minutes. After vigorous washing with running water, the structure shown in the lower photograph was obtained. It is apparent that the "old" rayon has completely disappeared from the fabric. This demonstrates the remarkable superiority of Zantrel to "old" rayon in resistance to caustic soda solution.

BLEACHING —— Bleaching of Zantrel fabrics, with a minimum of strength loss, is accomplished in Europe largely by the use of peracetic acid. In the United States, satisfactory results have been obtained with sodium chlorite. Hydrogen peroxide is a good bleaching agent for Zantrel fabrics but care must be taken to see that the goods have not come into contact with any soil containing iron. Sodium hypochlorite appears to be the least effective bleach for Zantrel.

DYEING——The dyeing of 100% Zantrel and Zantrel blend fabrics requires no specialized techniques nor equipment. In general, Zantrel can

be dyed as for cotton, and a Zantrel blend as for the corresponding cotton blend. However, it is necessary to first match for shade in the laboratory since some dyes give a slightly lighter shade on Zantrel than on cotton while some others give a slightly darker shade. Nevertheless, a full range of solid shades can be produced without difficulty on Zantrel/cotton intimate blends and ortho mixtures.

With regard to dyes, Zantrel has excellent affinity for all classes of dyes normally used for dyeing or printing cellulosic fibers. Practical experience has shown that lightfastness and washfastness of these dyes on Zantrel is equal to that obtained on cotton. Highly satisfactory results have been obtained in respect to penetration and levelness of dyeing with intimate blends of Zantrel and carded cotton; the presence of Zantrel reduces streakiness. The following is a list of the main classes of dyes for Zantrel fabrics:

a) vats, b) dyes developed on the fiber (azoics), c) indigosols, d) reactive dyes, e) sulfur dyes, f) washfast and lightfast directs, g) pigment dyes.

Of this group, vats are the most preferred and washfast and lightfast directs are the least preferred.

Equipment for the application of dyes to 100% Zantrel and Zantrel blend fabrics can be of various standard types. Continuous and semi-continuous dyeing by high-speed fixation processes (pad-steam, pad-high temperature, pad-liquid chemical, pad-hot oil, molten metal) are the preferred techniques. If it is necessary to use a beck or a jig, tension on the fabric should be as low as possible. This precaution applies to all fabrics regardless of the fiber content and it just makes good common sense.

FINISHING———As with wet processing and dyeing, 100% Zantrel and Zantrel blend fabrics can be finished satisfactorily on either the cotton or the "synthetic" system.

A remarkable feature of Zantrel fabrics is their inherent dimensional stability. Zantrel fabrics, with or without resin treatment, can be mechanically compression shrunk to less than 1% residual shrinkage, thus meeting the stringent requirements laid down for the Sanforized label. Progressive shrinkage in Zantrel fabrics is no greater than that of cotton fabrics. Once again the similarity between Zantrel and cotton, and the dissimilarity of these two fibers to "old" rayon is obvious.

Zantrel fabrics, in pure finish, have a crisp and lofty hand, with a soft toned luster, all of which are desirable characteristics of any fine quality fabric. However, individual converters, on occasion, may wish to vary the natural hand of the fabric. This can be accomplished in the conventional manner by the use of either softeners or thermosetting resins.

Although Zantrel fabrics, in pure finish, show rather good wrinkle recovery in the conditioned state, both dry and wet wrinkle recovery can be enhanced by the application of a small amount of thermosetting resin to the fabric.

"Easy-care" features can be conferred to Zantrel fabrics by the application of nonchlorine-retentive thermosetting resins of the type used on cotton for the same purpose. Resin solids add-on for Zantrel should be the same as for cotton, which is about one half that required for "old" rayon fabrics. When treated with these resins, Zantrel does not show the loss in strength generally encountered with cotton (up to 40%).

The high tensile and tearing strengths of Zantrel, together with its satisfactory behavior on resin treatment, are also favorable factors facilitating mechanical finishing treatments for producing luster and silk-sheen effects.

A residual shrinkage of less than 1% can be attained in blends of Zantrel with thermoplastic fibers by heat setting, followed by mechanical compressive shrinkage if necessary.

PERFORMANCE CHARACTERISTICS OF WOVEN OR KNITTED ZANTREL FABRICS

DIMENSIONAL STABILITY——— One of the most important characteristics of Zantrel fabrics is their inherent dimensional stability. Just as for cotton, they can be mechanically compression shrunk to within Sanforized limits, thereby eliminating initial shrinkage caused by wet processing. Zantrel fabrics are amazingly free from a progressive shrinkage, which is a major shortcoming of "old" rayon.

EASY CARE———In the ever-growing field of "easy-care" fabrics, Zantrel has a promising future. Its relatively high natural wet crease recovery, together with its moderate water absorption and high elastic recovery are favorable factors. In addition, an outstanding feature of Zantrel fabrics, attributable to its unique fiber structure, is the fact that a low concentration of resin (five to six percent solids add-on) gives good crease resistance and recovery characteristics. As contrasted with cotton, which may lose as much as 40% of its strength by such treatment, the strength of Zantrel fabrics is virtually unaffected, or in some cases may be increased. For these reasons, Zantrel is finding an important place in the field of very lightweight easy care fabrics, where neither cotton nor "old" rayon give consumer satisfaction.

TENSILE AND TEARING STRENGTHS——While the strength of a fabric, as such, is not of great consumer interest, this is not true of the influence of tensile and tear strengths on the wear life of a garment, where generally higher strengths give longer life. The markedly higher (100%) wet strength of Zantrel, as compared with "old" rayon, is indicative of its superiority.

Both the tensile and tearing strengths of resin-treated Zantrel fabrics are good. Tearing strengths of these fabrics are higher than "old" rayon fabrics, which in turn are higher than tearing strengths of resin treated cotton fabrics of similar construction.

AESTHETICS———The hand of a Zantrel fabric can be described in words such as crisp, lofty, silk-like, and luxurious. This hand can be modified in finishing to meet the specific requirements of a converter.

Zantrel fabrics have good drapability, a characteristic particularly important in apparel fabrics.

Zantrel fabrics can be dyed to any shade of the rainbow, from pale pastels through to dark blues, browns, and black. As compared with similarly dyed cotton fabrics, the colors of Zantrel fabrics are clearer and brighter.

The luster of Zantrel is one of its major assets. It has a distinctive pleasing luster of its own, which is soft toned and resembles that of silk.

A considerable amount of knowledge is now available in regard to the aesthetics of blends of Zantrel with natural and other man-made fibers. When blended with 50% cotton, for example, a carded yarn can be produced which has the regularity and appearance of 100% combed cotton. When blended with hydrophobic man-made fibers, Zantrel provides a more friendly hand and contributes extra comfort to the wearer

in the form of improved moisture transmission through the fabric.

OTHER CHARACTERISTICS——There has been no evidence of pilling in Zantrel fabrics.

Zantrel fabrics are machine washable over a wide range of temperature settings. They dry at the same rate as cotton and do not glaze in ironing.

Zantrel fabrics are similar to cotton in resistance to organic solvents.

END-USE OF WOVEN AND KNITTED ZANTREL OR ZANTREL BLEND FABRICS

A large number of this country's major textile companies have been developing fabrics containing Zantrel, both as 100% and in blends with natural and with man-made fibers. Most rapid progress has been made with women's and children's dress fabrics as well as men's shirting fabrics. These fabrics are now available commercially.

Promising developments, many of which are nearing completion, are in the following areas:

corduroys, velvets, print cloths, broadcloths, poplins, warp and filling sateens, bedford cords, fancy sateens, bastistes, and other woven fabrics.

In the knitted field, plain and fancy knits will be moving shortly into the areas of T-shirts, briefs, sport shirts, outerwear and other end-uses for knitted fabrics.

Aside from men's, women's, and children's apparel end-uses, there is considerable interest in the use of Zantrel in the drapery, upholstery, blanket, bedspread, sheeting, terry cloth, and towel fields.

Time has not yet permitted detailed exploration in such areas as zipper tapes, sewing thread, interlining, specialized end-uses in the paper industry, automotive head linings, and many other potential end-uses for this versatile fiber.

REFERENCE

(1) Tachikawa, S, *Rayon Synthetic Textiles* 32, No. 3, 31-3 (1951).

II. Dyeing and Finishing of New Cellulosic Fibers—— Enka Fiber 500

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Enka Fiber 500 is a regenerated cellulosic fiber chemically like ordinary rayon but having an internal physical structure that gives it higher wet modulus and much lower elongation. This results in low progressive shrinkage after mechanical compression, as in cotton. The behavior of rayon is preserved with respect to dyeing characteristics and processing into fabric. Resin requirements for a given stability and crease recovery are similar to those of cotton. Unlike cotton, however, the fabric loses little or no strength in resin treatment. End uses for which Fiber 500 fabrics appear suitable include women's blouses and dresses, men's sports shirts and T-shirts, suiting blends with polyester and acrylic fibers, and draperies.

INTRODUCTION

NEW and better fibers are coming out of the intensive research programs of both the cellulosic and the synthetic fiber manufacturers. They are being weighed carefully by the textile industry in the search for better value. In the field of man-made cellulosics, the new high modulus fibers have aroused much interest. The underlying principles contributing to their textile characteristics and fabric behavior have been dealt with in the literature by Lund, Scott, Sisson, Whytlaw, and others. This discussion will be limited to a brief summary of the main characteristics of one of them, Enka Fiber 500.

DISCUSSION

FIBER PROPERTIES——One of the major objectives in the development of Fiber 500 was to make important improvements over ordinary rayon with respect to inherent dimensional stability, amenability to the compressive shrinking process, and response to resin application for "wash-wear." The good processing performance of rayon had to be preserved, and the economics of the fiber had to be sound.

The outcome was a pure cellulosic fiber chemically similar to regular rayon but differing in internal physical structure. The effects upon some of the significant physical properties of the fiber, as compared with regular rayon, were:

1) Wet modulus at 5% strain increased three-fold, to the level of cotton.
2) Conditioned and wet elongation at break reduced to half, nearly as low as in cotton.
3) Fiber strength increased 10-15%.
4) Swelling in water reduced 10-15%.
5) Moisture regain at 60% RH reduced from 13.0% to 12.1%.
6) Degree of crystallinity, length of crystallites, and degree of orientation increased, according to accessibility and X-ray measurements.

Now let us examine briefly how these changes affect the processing of the fiber into fabric, the dyeing and finishing of the fabric, and the usefulness of the fabric.

FIBER AND FABRIC PROCESSING——Conversion of Fiber 500 staple into fabric, in 100% form or when blending with other fibers, is quite satisfactorily accomplished by virtually the same procedures as used for regular rayon. No more than minor adjustments of machinery are likely to be needed. Break factors of yarns spun by the cotton system have been found generally to be about the same as in high-quality regular rayon or comparable cotton yarns. Because of the low elongation of Fiber 500, it is preferable to keep slasher stretch at a minimum (1 to 2½%) to obtain best weaving performance.

Normal rayon singeing, desizing, boiling-off, and dyeing procedures and equipment are suitable also for Fiber 500. The hand of plain finished fabrics is slightly firmer than that of regular rayon.

A complete study is not available on the mercerizing of combination and blend fabrics made of cotton and Fiber 500. Some of the data indicate, however, that mercerizing of such fabrics may prove feasible. Fiber 500 swells significantly less than ordinary rayon in caustic soda solutions ranging from dilute to mercer-

TABLE I

Shrinkage of plain finished fabrics in home-type washing

	% Shrinkage					
	Cotton		Regular rayon		Fiber 500	
	W	F	W	F	W	F
One wash	5.8	2.9	11.2	9.4	6.0	4.4
Five washes	7.2	2.9	16.5	12.2	8.8	4.4
25 washes	9.0	3.8	19.8	12.7	9.8	5.2
Progressive shrinkage	3.2	0.9	8.6	3.3	3.8	0.8

TABLE II

Shrinkage in boiling wash after compressive shrinking treatment

	% Warpwise shrinkage	
	Regular rayon	Fiber 500
One wash at 212°F	2.4	1.2
Ten washes at 212° F	6.0	2.4
Progressive shrinkage	3.6	1.2

izing concentration. Samples of 100% Fiber 500 yarn and fabric treated with mercerizing lye at fixed dimensions, then washed and dried, show little or no loss of strength, whereas regular rayon loses 30-40% in the same treatment.

DYEING CHARACTERISTICS——In general the dyeing properties are similar to those of regular rayon, but the relationship varies to some extent from one dye to another. For example, some vats, directs, and sulfurs have slightly greater affinity for Fiber 500 than for regular rayon; others in each class have slightly less. The only significant difference found so far between the two fibers with respect to lightfastness, washfastness, and crockfastness is that the washfastness of direct dyes on Fiber 500 is somewhat better.

DIMENSIONAL STABILITY——Fabrics made of Fiber 500 shrink much less in laundering than regular rayon, being more like cotton in this respect. This is true of both the relaxation shrinkage in the initial wash and progressive shrinkage in repeated washing. The higher wet modulus, the altered crystalline structure, and the lower swelling of Fiber 500 are believed to be largely responsible for the improvement. The magnitude of the shrinkage differences is illustrated in Table I by the shrinkage data found in a recent home machine laundering comparison at 140°F of plain finished 76 × 74 fabrics made of 30's warp and filling yarns.

In another comparison using fabrics of the same construction, but washing at 160°F, the cotton shrank 6% warpwise in 50 washes, regular rayon shrank 22%, and Fiber 500 shrank 9%.

In addition to its inherent advantage in stability, Fiber 500 responds quite well to a compressive shrinking treatment such as the Sanforized process. A good example is a comparison made between it and regular rayon in challis, in which both were subjected to the severe test of 10 boiling washes after compressive shrinking treatment; the data are given in Table II.

BEHAVIOR UPON RESIN TREATMENT——The resin requirements of Fiber 500 are about two-thirds those of regular rayon, or only slightly more than for cotton, for a given level of crease recovery, stability, and easy care properties. This seems to be associated with its higher modulus and greater crystallinity. However, it exhibits rayon's favorable characteristic of retaining most, if not all, of its dry strength and gaining wet strength when resin treated, whereas cotton loses sharply. The net result usually is for Fiber 500 goods to be stronger than cotton in both the dry and the wet state, after resin treatment.

At a good level of dry crease recovery, for example 270°, Stoll flex abrasion resistance and strength of resin-finished fabrics made of Fiber 500 approach those of regular rayon. "Wash-wear" ratings are noticeably better, however, apparently because of the higher ratio of wet to dry crease recovery.

END USE FABRICS——Evaluation in 100% form and in blends with other fibers is still in progress. In the men's and women's woven apparel field, 100% Fiber 500 is showing promise in challis, gabardine, and print cloth constructions. Knit goods such as men's T-shirts are being studied. In household drapery fabrics, the reduced elevator effect and the dimensional stability in washing that can be obtained by applying only a compressive shrinking treatment are proving attractive. An exploration of a variety of blends with polyester, acrylic, and acetate fibers is in its early stages. Here the attention probably will be focused largely on lightweight suitings, shirtings, and blouse fabrics.

III. An Introduction to the Dyeing and Finishing of Corval®, Topel®, and Moynel®

R S KENYON

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Courtaulds (Alabama) Inc

Continuing fiber research on the part of the Courtaulds organization has led to the development of several new cellulosic fibers for the textile and allied industries. Most recently it has introduced the family of cross-linked staples, Corval and Topel, along with the high wet modulus fiber, Moynel.

Cross-Linked Staple. In general it may be stated that the family of cross-linked fibers may be prepared and dyed as regular rayon with only slight modifications. Mercerization, however, is possible with newer members of this family. Fabrics made from these fibers are said to be relatively stable, requiring little resin for complete stability in the 100% form. In blends with the newer synthetics up to 50% they do not require resination for stability or high crease angles, it is claimed. Excellent "wash-and-wear" fabrics reportedly have been prepared in the pure finished state.

Moynel. Moynel reportedly is being successfully prepared, dyed, and finished on conventional cotton equipment including mercerization and compressive shrinking. It is said to require approximately the same level of resin solids as cotton to achieve stability and high crease angles without the normal loss in tensile strength associated with cotton. In blends with carded cotton the resultant fabrics reportedly have a combed cotton appearance.

INTRODUCTION

CONTINUING fiber research on the part of the Courtaulds organization has led to the development of two distinct new families of cellulosic fibers for the textile and allied industries. The cross-linked staples may be defined as three-dimensional polymers of cellulosic units chemically combined through methylene ether linkages. Moynel, on the other hand, is a regenerated cellulosic with a very high degree of crystallinity, with a smooth cross section and tending to be fibrillar. My purpose here is to very briefly explain the work on the dyeing and finishing aspects of these fibers.

DISCUSSION

CROSS-LINKED FIBERS —— Let us first confine ourselves to a brief discussion of the cross-linked staples. In general, it may be stated that Corval and Topel may be dyed as ordinary Fibro with only minor modifications. The water imbibition, or relative swelling of these fibers, is reduced considerably over rayon. The water imbibition of Corval ranges from 50% to 55% while that of Topel ranges from 60% to 65%. For comparison, the water imbibition of rayon is 110% to 120%. This, of course, reduces the rate of take up into the fiber. The actual rate is determined by the molecular size of the dyestuff employed with the smaller molecular configurations not exhibiting the extreme differences noted with the larger, more slowly diffusing types.

It should be noted, however, that all shades which are obtainable on rayon with directs can be achieved on the cross-linked staples by increasing the amount of salt in the bath to aid in the exhaustion of the dyestuff.

By use of the Colormaster Differential Colorimeter, we have noted the following on laboratory dyeings:

1) The effect of lowering the liquor ratio is much more pronounced on Corval than on Fibro.

2) Corval dyeings require a slightly longer dye cycle to reach equilibrium.

3) As noted above, by increasing the salt concentration one can achieve equivalent shades to those obtainable on rayon.

The effect of all these variables is directly related to water imbibition. By this we mean as the water imbibition increases you require less additional salt to achieve the same shade. At equal salt concentrations, higher water imbibitions imply shorter dyeing times. When using vats on Corval, shades equivalent in depth to those obtainable on rayon have been achieved by merely increasing the length of the dyeing cycle. It should also be noted that vats dye more uniformly on Corval than on rayon due to Corval's reduced swelling in caustic. Corval's swelling in caustic soda solutions and in water is, in fact, reduced some 50 percent over that of Fibro.

In all plant trials to date, we have not experienced any problems in dyeing Corval with regard to depth or fastness of shade. Dyefastness on the cross-linked staples is equivalent to that on rayon.

Fabrics made from these fibers are relatively stable, exhibit little or no progressive shrinkage and necessitate very little resin for good stability. "Wash-and-wear" fabrics in a 100% blend have been prepared utilizing only seven percent dimethylol ethylene urea resin solids on the fabric. Stability and high crease angles in the 250°-260° range wet and dry have been obtained. This, of course, depends upon fabric construction and more or less resin may be needed. Our work to date has been mainly on the ethylene-urea type of resin although some work has been done with the reactant types of acetals.

Blends up to the 50 percent level with the newer synthetics do not normally require resination. We have worked with triacetate, various acrylics, and various polyesters. Up to this 50 percent blend level, such fabrics require only heat setting to achieve complete stability with high crease angles both wet and dry.

The crimped cross-linked staples have a firmer hand with more bulk and resultant cover than regular rayon and are a decided advantage in these blends. The hand is comparable to that of a resin-finished viscose blend and is permanent for the life of the garment whereas a resin-treated piece gradually loses its hand on repeated launderings.

I repeat. The bulking characteristic of these fibers gives cover heretofore unobtainable with ordinary rayon in the blends. Excellent "wash-and-wear" fabrics have been produced in the pure finished state. An obvious bonus is obtained since no resin is needed.

HIGH WET MODULUS FIBERS

Moynel is the Courtaulds trade name now utilized in describing our high wet modulus fiber previously designated SM-27.

No problems have been experienced in the dyeing of Moynel and dyestuffs normally utilized on cotton or rayon may be successfully applied. No apparent difference in fastness properties has been observed. While the dye affinity is slightly less than that of rayon, it is greater than that of cotton.

It has been and is presently being prepared and dyed on conventional cotton equipment including vat dyeing on a continuous range.

In blends with cotton or at the 100 percent level, this fiber has been successfully mercerized and compressive shrunk to the required stability. Mercerization, or, perhaps more correctly, caustic treatment, has been carried out with concentrations of sodium hydroxide from 14 to 56 degrees twaddle with no problems.

Compressive shrinkage has been accomplished on broadcloths, challis, and gabardines both with and without prior caustic treatment.

With regard to caustic treatment, we have found that a sodium hydroxide concentration of six to eight percent yields optimum results. The benefits derived from this treatment are many, namely the following:

1) Moynel exhibits the same shrinkage characteristics as cotton but with caustic treatment, the fabric is semistabilized with the potential shrinkage reduced by some 50 to 60 percent at 100 percent fabric yield.

2) By caustic treatment in six percent sodium hydroxide, loss in tensile strength due to repeated launderings is completely abrogated. This loss in tensile strength upon laundering is common to all regenerated cellulosics but not to cotton.

3) With this treatment an immediate increase in wet crease angle is realized—so much so that drip dry ratings of 4 on the Monsanto scale have been achieved without resination.

4) We achieve greater dye affinity.

5) The hand of the fabric is firmed up considerably so that in most cases hand builders are not needed.

6) A luster is obtained which is more silk-like than rayon-like.

7) Seam ravelling, long a problem in synthetic fabrics, is completely eliminated by this caustic treatment.

Without prior caustic treatment, Moynel exhibits approximately the same behavior with regard to crease recovery angle as cotton with the EU resins used in our work. Moynel, unlike cotton, does not lose tensile strength with resin add-on and

Moynel, like cotton, requires only small amounts of resin for excellent stability to laundering. As with all cellulosics a compromise must be made between crease recovery angle, abrasion resistance, and other properties for optimum results.

Caustic-treated fabrics require only small amounts of resin to achieve "wash-and-wear". Broadcloths and gabardines caustic-treated with 6% sodium hydroxide need only four percent resin solids to achieve a high rating on the Monsanto scale. This, of course, is due to the high wet crease angles obtained by caustic treatment alone.

Our work with both knit goods and woven fabrics leads us to say in general that Moynel may be processed from start to finish as cotton. As with Corval, due to its firmness and inherent stability, blends with heat-settable fibers up to the 50 percent blend level do not require resination for stability, hand, or appearance. In blends with carded cotton, one may achieve a combed cotton appearance without any detrimental effects plus the advantages previously stated.

It has long been known that peroxide bleaching has been detrimental to rayons in general due to the presence of trace metals in either the bath or the fiber. This was found also to be true with the high wet modulus fibers and as a result, work was initiated to overcome this.

Recently the Research Department of Courtaulds has found a method tending to eliminate this on Moynel and it should be applicable to all regenerated cellulosics.

On the basis of experimental data, excellent results may be obtained by the use of 5% TSPP (tetra sodium pyrophosphate) in conjunction with 0.1% of the tetra sodium salt of ethylenediamine tetra acetic acid (EDTA-Na_4)—both based in the weight of the fabric. Work has been done in a pH range of 9-11 with a pH of 10 being used for the majority of the trials. Fiber degradation was estimated by fluidity changes as they are more absolute than tensile strength losses. Fluidities in reciprocal poises ranged from 7 to 31 with the acceptable limit being in the 7-10 rhe range. Whiteness values in this area were considered acceptable as determined by the Colormaster Differential Colorimeter.

IV. Avron, Avril and Avlin—Three New Fibers from Avisco

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Avril. Avril, or Fiber 40 as it is known in fiber form, is a new high wet modulus fiber.

Its inherent property of low elongation both wet and dry reportedly makes possible rayon fabrics which can be mechanically stablized by compressive shrinkage techniques.

Avril has a cross sectional swelling of 55% compared with regular rayon at approximately 100%. It also is said to have greater resistance to caustic soda, which permits mercerization when desired, such as in blends with cotton.

Its dry strength is reported to be about 10% higher than regular rayon while its wet strength is approximately 30% greater.

Avril fabrics or Avril blended fabrics require no special preparation and can be processed with greater wet tension than regular rayon, it is claimed.

Avril reportedly accepts all classes of dyes normally used in dyeing cellulosic fibers.

Avlin. Avlin rayon is a multicellular rayon fiber which is said to possess unique properties found in no other rayon staple. When wet with water and dried, Avlin rayon fibers reportedly will bond firmly to themselves and to other cellulosics. Avlin is said to have a broad flat cross section which, along with its unique bonding properties, provides a firm, crisp linen-like hand.

Avlin is thought of more as a blending fiber than in 100% fabrics. 10 to 30% Avlin blended with other cellulosics, acrylics or polyesters seems to show the most promise.

Fabrics made from Avlin reportedly can be prepared the same as fabrics containing regular rayon.

Avlin is said to accept all classes of dyes normally used for cellulosics.

Avron. Avron, or XL as it is known in fiber form, is a new high-strength rayon fiber said to be 30% stronger dry and 50% stronger wet than regular rayon. The abrasion resistance of Avron reportedly is approximately double that of regular rayon. The cross section of Avron resembles that of the kidney bean with a relatively regular surface. The fiber has a semidull appearance resulting from the gas voids within its structure.

Avron fabrics require no special preparation and can be processed as easily as regular rayon, it is claimed.

All classes of dyes for cellulosic fibers reportedly may be used to dye Avron to a full range of shades.

AVRON RAYON

AVRON rayon, or XL as it is known in fiber form, is the strongest of American Viscose Corporation's staple fibers. It was specifically developed as a cellulosic fiber featuring both high strength and high elongation. This combination of properties yields a tough fiber which possesses improved abrasion qualities in addition to excellent tensile strength.

The dry tensile strength of Avron rayon in fabric is 30% greater than that of regular rayon fabrics of comparable construction and the wet tensile strength of the Avron fabric is approximately 60% greater than that of the regular rayon.

Avron rayon is essentially regenerated cellulose. Its cross-section is generally kidney bean shaped and the fiber is considered to be an all skin type which makes it particularly resistant to fibrillation.

The development of this high strength fiber opens new dimensions in textile technology. Luxurious, sheer "wash-and-wear" fabrics never before possible can now be made through the use of Avron rayon in combination with cotton. Avron rayon in these fabrics can take resin finishes and still retain its high tensile strength. Conventional cotton lawns when resin finished have shown unacceptable filling tensile and tear strengths. In such a fabric, when the cotton filling is replaced with Avron rayon, the tensile strength is up to 90% better and the tear strength more than 150% better.

Avron rayon filled broadcloth shirtings have shown similar improvements, as have other critical cotton constructions.

Avron rayon has found considerable use as a blending fiber with triacetate and polyesters, as well as in fine count apparel fabrics made entirely of Avron rayon.

Fabrics of 100% Avron rayon or blends of Avron with the synthetics require no special preparation over that normally used for regular rayon. However, fabrics made from combinations of cotton and Avron rayon must be processed in a different man-

ner than cotton. They may be processed in an open kier or in a continuous J unit; however, caustic should be kept to a minimum. Such fabrics should not be processed in a pressure kier; neither should they be mercerized. Mercerization with caustic soda reduces the strength of Avron rayon approximately 50% and stiffens the fiber considerably. Mercerization can be accomplished satisfactorily, however, through the use of potassium hydroxide.

All classes of dyes for cellulosic fibers may be used to produce a full range of shades on Avron rayon fabrics. Dyeing is done on conventional dyeing equipment by the same procedures used for regular rayon. As with any other high-tenacity-type fiber, Avron rayon tends to take dyestuff less rapidly than regular rayon. Avron rayon dyes similarly to unmercerized cotton and thus somewhat lighter and duller than rayon. In the dyeing of dark shades with direct dyestuffs, the use of additional quantities of salt has proven beneficial in achieving a full depth of shade.

Although visually, Avron rayon appears to be lighter in depth than comparably dyed regular rayon, dyebath transmission studies have shown that total exhaustion of the Avron rayon bath is normally 5 to 10% greater than that of regular rayon. This apparent depth difference is attributed to Avron rayon cross-section and to the distribution of dye within the fiber.

Inasmuch as Avron rayon is a strong, high elongation fiber, it is more affected by over-stretching during processing than regular rayon. The same conditions of stretch or strain when applied to a regular viscose fabric might break or tear it, while a fabric made from Avron rayon would only be elongated. This elongation, or stretch, will result in fabric shrinkage if the fabric is not properly relaxed at final drying.

Fabrics made entirely of Avron rayon or blends of Avron with other fibers must be resinated or chemically treated to obtain dimensional stability. Avron rayon accepts and responds to resination much the same as regular rayon. Avron rayon's higher initial strength provides better tensile strength, tear strength, and flex abrasion after resin treatment than other rayons or cotton.

AVRIL RAYON

Avril rayon, or Fiber 40 as it is known in fiber form, is a new high wet modulus staple fiber manufactured by the American Viscose Corporation. This fiber represents a whole new concept in cellulose chemistry in that it offers low elongation in both the wet and dry state. These properties compliment Avril's inherent stability which is similar to that of cotton.

The cross-section of Avril rayon appears unserrated, but quite irregular in shape. The semidull appearance of the fiber is due to gas voids within the fiber.

The stress-strain properties of Avril rayon also place it in a class with cotton. Conditioned fiber tests show Avril rayon to be about 3.2 grams per denier at 9.5% extensibility compared to cotton at 3.65 grams per denier at 10% extensibility. Regular rayon by comparison is 2.75 grams per denier at 24.5% extensibility.

In the wet state, Avril rayon provides tensiles of 2.4 grams per denier at 10.5% extensibility and cotton, 4.20 grams per denier at 13% extensibility. Regular rayon has only 1.6 grams per denier at 29% extension.

The swelling of Avril is also more like that of cotton than regular rayon. Avril shows a cross-sectional swelling of approximately 55% while cotton is 30% and regular rayon is approximately 100%.

The preparation of 100% Avril fabrics is similar to that followed for the preparation of regular rayon fabrics. It will be observed, however, that less care as far as stretching will be required due to the low extensibility of the fiber. There will also be less processing shrinkage occurring.

In the preparation of blends or mixtures of cotton and Avril rayon, these should follow the general routing of the normal continuous processing for similar cotton fabrics. Avril has a much greater resistance to caustic soda than regular rayon and so can be mercerized when required.

The preparation of blends of polyesters and Avril rayon should follow the same general routing as similar blends of polyester and cotton except that mercerization is not necessary.

Bleaching of Avril rayon can be satisfactorily accomplished using any of the conventional bleaching agents such as peracetic acid, sodium chlorite, sodium hypochlorite, and hydrogen peroxide. When bleaching with hydrogen peroxide, it is necessary to add a sequestering agent such as Perma Kleer 80 or Versenex 80 to the bleaching bath to insure against loss in physical properties.

Avril rayon can be readily dyed with all classes of dyes normally applied to cellulosic fibers by commonly used techniques.

Direct dyeing characteristics are different from regular rayon with the rate of exhaustion being slightly slower and shades somewhat duller in appearance. Comparative dyeings place direct dyes on Avril rayon into three classes with respect to regular rayon. Group I includes those dyes which dye Avril slightly darker, Group II includes those dyes which dye Avril rayon and regular rayon about the same depth, and Group III includes those dyes which dye Avril rayon lighter. All major dye vendors have been supplied Avril fabric for evaluation of their dyestuffs and it is suggested that they be consulted for information on their respective products.

It is suggested that Avril rayon be dyed as close to the boil as possible and that in dark shades additional salt may be necessary to promote exhaustion.

The high initial wet modulus, the low extensibility and Avril's greater resistance to caustic soda make possible the application of vat dyes by continuous processes.

We are presently making a study of package dyeing of Avril rayon, but at this time are not ready to report on it. It is expected, of course, that the dyeing of finer count yarns as compared with regular rayon will be possible due to the lower swelling of the fiber.

Fabrics made from 100% Avril rayon or blends of Avril rayon with cotton or polyesters can be made dimensionally stable through mechanical compressive shrinkage techniques.

When it is desirable to finish fabrics made entirely of Avril rayon or Avril rayon/cotton blends to obtain crease resistance and ease of care properties, it is suggested that the amount of resin solids on the fiber be kept to a minimum, preferably below 5%. Above this concentration Avril rayon shows some loss in physical properties; however, not nearly as great a loss as cotton shows.

Blended fabrics of Avril rayon/polyester may be made dimensionally stable by heat setting and relaxed drying, or if processed similar to a polyester/cotton fabric under tension, the residual shrinkage may be reduced by compressive shrinkage machines.

Polyester/Avril rayon blends can also be given a special finish consisting of schreiner calendering prior to

heat setting at about 20 tons nip pressure at from 350 to 400°F while the fabric has about 30% moisture present. This technique of finishing produces a fabric having improved cover, crispness, luster and reduced processing shrinkage. The effects are durable to repeated launderings.

The automatic "wash-and-wear" properties of the polyester/Avril rayon blend are superior to those of polyester/cotton and the fabric is more absorbent than the cotton blend which should make it a more comfortable fabric to wear.

AVLIN RAYON

Avlin rayon, or RD-100 as it is known in fiber form, is a multicellular rayon fiber with unique properties found in no other staple fiber. When wet with water and dried, RD-100 rayon fibers will bond firmly to themselves or to other cellulosics. The degree of bonding is almost directly proportional to the amount of Avlin rayon present in the end product.

In textile applications, Avlin rayon can make interesting contributions. Rayons generally provide a soft, luxurious hand in fabrics, and while this is often desirable, in some cases a firm, crisp, linen-like hand is sought. Avlin rayon will provide this better than any other rayon available. This is brought about in part by the bonding properties of the fiber and, in part, by its unique shape, Avlin rayon having a broad, flat cross-section. The fiber has very thin, compliant walls which permit adjacent fibers to come into such close contact that strong cohesive forces are established.

Fabrics made from 100% Avlin rayon have been produced and should be of interest where a very stiff hand is desirable. However, it is felt that the largest use for Avlin rayon will be found in blends with other rayons, acrylics, polyesters, or natural fibers. Avlin rayon contributes greatly to improved crispness and fullness of hand, the degree being dependent upon the percentage of the blend. For most applications, 10 to 30% of Avlin rayon will impart the desired properties. This crispness and fullness is derived not only from its bonding properties but in part from the shape of the fiber which permits it to intertwine and restrict the movement of the other fibers in the yarn. For instance, in a blend with the true synthetics, Avlin rayon prevents the fibers from packing, thereby giving added fullness and firmness.

The firmness derived from the entwining of the Avlin rayon fibers is permanent and independent of the method of drying or finishing. The firmness derived from the bonding is dependent upon the cellulose fibers being in close contact during drying and these bonds can be broken by mechanical working. These bonds, however, are restored by rewetting and redrying.

Fabrics made from Avlin rayon either 100% or in blends with other fibers, should be prepared in the same manner as a similar fabric made with regular rayon.

Normal procedures for singeing, desizing, scouring and bleaching regular rayon can be followed.

In blends with the polyester fibers, where heat setting is required, normal conditions of temperature and time suggested for the thermoplastic fiber should be employed.

Avlin rayon can be dyed on the same equipment used for dyeing regular rayon. No modifications are necessary. Dyestuff exhaustion on Avlin rayon is quite similar to regular rayon. However, the depth of shade obtained may be somewhat different. Dye formulations established for use on regular rayon should not be used on Avlin rayon without first making a sample dyeing since some adjustments may be necessary. In general, Avlin rayon tends to dye somewhat lighter than regular rayon.

Fabrics made from bright Avlin rayon demonstrate a glitter or highlighting which becomes more pronounced as the depth of shade is increased. This glitter is attributed in part to the ribbon-like cross-section of the fiber which produces light-reflectance characteristics different from regular rayon, and to the partial transparency of the fiber. In many instances, this glitter is desirable as it makes possible many unique effects. In dull Avlin rayon fabrics, the glitter is subdued and so fabrics with a wide range of surface characteristics can be produced.

The finishing of Avlin rayon parallels the finishing of regular rayon. Fabrics made entirely of Avlin rayon or blends of it with other fibers require chemical treatments to obtain dimensional stability. If crease resistance is desired, it is necessary to use suitable resins. The swelling of Avlin rayon is greater than that of regular rayon and reduced concentrations of resin should be used.

Since Avlin rayon contributes crispness and bulk to blended fabrics, it is generally not necessary to use surface or partially polymerized resins to build the hand. Consequently, the hand obtained through the use of Avlin rayon is a natural hand which is retained through repeated launderings and is not dependent upon the durability of a chemical hand modifier.

AATCC Calendar

COUNCIL, COUNCIL COMMITTEES, RESEARCH COMMITTEES
Jan 18-20 (Sheraton-Atlantic Hotel, New York, NY); Jan 18-19—Cpuncil Committees and Research Committees; Jan 19 (PM)—ECR, TCR; Jan 20 (AM)—Council

NATIONAL CONVENTIONS
Sept 27-29, 1961 (Hotel Statler, Buffalo, NY); 1962 (Atlanta Biltmore Hotel, Atlanta, Ga); 1963—Boston; 1964—New York; 1965 (Conrad Hilton Hotel, Chicago, Ill)

DELAWARE VALLEY SECTION
Jan 13 (Kugler's Restaurant, Philadelphia, Pa); Mad 3 (Beck's on the Boulevard, Philadelphia, Pa); Apr 14 (Ladies Night—Cherry Hill Inn, Haddonfield, NJ); May 19 (Outing—North Hills CC, North Hills, Pa); Sept 15 (Wilmington, Del); Oct 27 (Beck's); Dec 1 (Beck's)

HUDSON-MOHAWK SECTION
Jan 13 (Jack's Restaurant, Albany, NY—paper on Nonwoven Fabrics); Mar 10 (Johnstown, NY—paper on "Wash-and-Wear" Fabrics); Apr 14 (Waterford, NY—plant tour of General Electric Co's Silicone Div); May 12 (Ladies Night); June 23 (Outing—Antlers Club, Amsterdam, NY)

METROPOLITAN SECTION
Jan 20 (Hotel New Yorker, New York, NY—"AATCC Goals"—Elliott Morrill, Corn Products Co, AATCC president; Feb 17 (Hotel New Yorker, New York, NY—"New Developments in Dye Assistants"—R J Thomas, DuPont Co); Mar 24 (Kohler's Swiss Chalet, Rochelle Park, NJ); April 21 (Kohler's Swiss Chalet, Rochelle Park, NJ—"Importance of Bow and Skew"—Lucille Rea, Simplicity Patterns, and John Robertson, Mt Hope Machine Co); May 19 (Kohler's Swiss Chalet, Rochelle Park, NJ—Ladies Night.

MID-WEST SECTION
Feb 4 (Sherman Hotel, Chicago, Ill); April 15 (Schroeder Hotel, Milwaukee, Wis); June 24 (Annual Outing—Ceramí's Island View Resort, Burlington, Wis)

NIAGARA FRONTIER SECTION
Apr 7 (Joint meeting with Ontario Section, CATCC, St Catherines, Ont); May 18 (Buffalo, NY)

NORTHERN NEW ENGLAND SECTION
Jan 20 (Hotel 128, Dedham, Mass—Symposium on "Mechanical and Chemical Finishing of Textile Fabrics"—John J McDonald, Lowell Technological Inst; D D Gagliardi, Gagliardi Research Corp; and Werner von Bergen, J P Stevens & Co, Inc); May 5-6 (New England Regional) Meeting, Jug End Barn, S Egremont, Mass

PIEDMONT SECTION
Jan 21 (Poinsett Hotel, Greenville, SC); April 2 (Washington Duke Hotel, Durham, NC); June 9-10, 1961 (Outing—Grove Park Inn, Asheville, NC); Sept 23, 1961 (Hotel Charlotte, Charlotte, NC)

SOUTH CENTRAL SECTION
Feb 18 (Wimberly Inn); Apr 15 (Hotel Patten); June 16-17 (Summer Outing—Riverside Hotel); Sept (Hotel Patten—tentative)

WESTERN NEW ENGLAND
Mar 17 (Shelton, Conn); May 5-6 (New England Regional Meeting, Jug End Barn, S Egremont, Mass); May 19 (Ladies Night—Rapp's Paradise Inn); June 9 (Annual Outing); Sept 15 (Plant visitation); Oct 27 (Annual Meeting); Dec 1 (Shelton, Conn)

COUNCIL HIGHLIGHTS

221st Meeting • November 18, 1960 • Sheraton-Atlantic Hotel, New York, NY

COUNCIL held its 221st meeting and the last under the administration of outgoing president Weldon G Helmus on November 18, 1960. Mr Helmus, concluding his two years as president, commented on the fact that Council had been able to conduct its business in less than an hour. He attributed this to the current procedure in which the Executive Committee meets prior to the Council session, enabling the vice presidents to brief their regional Councilors beforehand and discuss matters that would come up in Council.

* * *

Chief actions by the Council were approval of an $18,300 budget for the 1961 Convention Committee, and authorization for the Committee to obtain an additional advance of $3,000; approval of the boundaries of the Piedmont and Northern Piedmont Sections; approval of a limit of $20,000 on Convention Reserve, with surplus funds to be placed in a special contingency fund, subject to discussion with Price Waterhouse & Co; and the defeat of a proposal that the chairman of the Executive Committee on Research become a voting member of the Executive Committee.

* * *

Council was informed that AATCC's application for membership in the International Federation of Associations of Textile Chemists and Colorists had been acknowledged. However, due to the fact that IFATCC is undergoing reorganization and is not prepared to expand its membership at this time, the Executive Committee recommended that the application be withdrawn until such time as the Federation was prepared to issue an invitation to AATCC. Council deemed the action appropriate.

* * *

Reporting for the Executive Committee on Research and the Technical Committee on Research, ECR Chairman Charles A Sylvester reported that the Committee had been devoting a major share of its attention to a survey and study being conducted on AATCC research objectives by a subcommittee of ECR under the chairmanship of Fred Fortess.

S J O'Brien, American Cyanamid Co, has been appointed chairman of the Committee on Soiling of Carpets and V S Salvin, Celanese Fibers Co, has been appointed chairman of the Committee on Colorfastness of Textiles to Atmospheric Contaminants. Approximately twenty new appointments to various research committees have been confirmed by ECR. Mr Sylvester noted that the membership on research committees was being broadened.

ECR has approved a proposal of the Committee on Washing, RA-60, that a letter ballot be circulated to TCR providing for 1) the use of the one-pint metal cylinder available from Atlas Electric Devices Co, or the present one-pint glass jar, be optional in AATCC test 36-1957 and in Wash Test I-A of AATCC 61-1960; and 2) that the use of cotton effect fibers only be recommended for determining staining in Wash Tests III-A and IV-A of AATCC 61-1960. The use of multifiber test fabric would be optional but staining of acetate, nylon, silk and wool should be disregarded unless one of these fibers was present in the fabric being tested or known to be in the final garment.

ECR has approved the proposal of the Committee on Identification of Finishes of Textiles, RA-45, that a letter ballot be circulated to TCR calling for the addition of procedure to cover category 2-C, Antibacterial and Mildewproofing finishes to AATCC Tentative Test Method 94-1959, Analysis of Finishes.

ECR will invite an AATCC member, thoroughly knowledgable in the field of nuclear radiation, to review on an ad hoc basis the present status if what is being done in this field that may have long-range impact on the textile and related industries, and to recommend what types of activity AATCC should engage in to insure proper planning for the Association to serve the industry in this area.

* * *

Herbert A Stauderman, chairman of the Committee on Individual Membership, announced to Council the results of the Membership Drive Contest which expired at noon, October 8, at the Philadelphia Convention. As noted previously, the Western New England and Piedmont Sections were winners in their respective groups. Of the fourteen Sections competing, thirteen showed increases. Western New England led Group 1 entries with a 20% increase followed by Washington with 16%, Pacific Northwest 15%, Niagara Frontier 13%, Hudson-Mohawk 11%, South Central 10%, and Pacific Southwest 4%. In Group 2, Piedmont led with a 12% increase, followed by Delaware Valley with 6%, Metropolitan, 5%, Mid-West 3%, and Northern New England and Southeastern with 1%. Rhode Island showed a 2% decrease. Mr Stauderman paid tribute to the Delaware Valley Section for its cooperation in support of the Committee during the Convention.

The efforts of the Committee on Individual Membership were borne out in the report of the Committee on Membership and Local Sections. The executive secretary noted that there were 280 more members on the rolls than at the same time last year.

* * *

Agreement has now been reached on the boundaries of the new Northern Piedmont Section and the reestablished boundaries of the Piedmont Section.

The Piedmont Section boundary has been established as that portion of the states of North Carolina and Virginia, west of a line from Roaring Gap, NC due north to the latitude of Richmond, Va; and southwest of a line from Roaring Gap to Ellerbe, NC and south of a line due east from Ellerbe to the Atlantic Ocean.

For the Northern Piedmont Section, the boundary has been established as that portion of the state of North Carolina and Virginia consisting of the area lying within a line from Roaring Gap, NC due north to the latitude of Richmond, Va; and along that latitude east to the Atlantic Ocean; and within a straight line southeast from Roaring Gap to Ellerbe, NC and within a straight line due east to the Atlantic Ocean.

Every member in the areas of the Sections concerned has been given an opportunity to indicate his choice of Section affiliation.

* * *

The executive secretary presented a proposal from A H Gaede as the original proponent, signed by more than 100 Senior members, to amend Article V, Section 2 of the Constitution to delete the words "the past president" and insert "each past president for the four years following expiration of his term of office as President." If the Constitution was

amended to limit membership on the Council to four years subsequent to holding office as president, the amendment would become effective as of December 31, 1960 and have no effect on those past presidents now serving on the Council whose terms of office as president expired prior to December 31, 1960. The proposal was referred to the Committee on Constitution and Bylaws in accordance with Article VIII of the Constitution.

* * *

The next meeting of the Council has been scheduled for 10 am, Friday, January 20, at the Sheraton-Atlantic Hotel in New York. Council committees and research committees have been scheduled for January 18 and the morning of the 19. An informal general luncheon has been scheduled for Thursday, the 19th, to be followed by a meeting of TCR, ECR, and the Executive Committee of the Council.

(Photo by Edward Artim)

Outgoing President Weldon G Helmus (standing) discusses item of business at 221st Council meeting with his successor, Elliott Morrill (second from left) and Vice Presidents Joseph H Jones (far left), A Henry Gaede (center) and William S Sollenberger. All three vice presidents and W George Parks, the Association's other vice president who was not in attendance when photo was taken, were reelected for another year. Mr. Morrill succeeded Mr Helmus as president on January 1.

MEMBERSHIP APPLICATIONS

December 8-21, 1960

NEW ENGLAND REGION

Northern New England Section

Senior

Warren L Hartwell—Dyer, Ansonia Mills Inc, E Taunton, Mass. Sponsors: H B Sturtevant, R J Prunier.

CENTRAL ATLANTIC REGION

Metropolitan Section

Senior

Rudolph P Georgion — Textile chemist, Pharma Chemical Corp, Bayonne, NJ. Sponsors: G M Kidder, G J Mandikos.

Transfer to Junior

Bipinchandra R Shukla—Textile chemist, Sonneborn Chem & Refining Corp, Belleville, NJ. Sponsors: J Turer, J K Smith.

Delaware Valley Section

Senior

Bernard H Kress—Research chemist, Quaker Chemical Products Corp, Conshohocken, Pa. Sponsors: J H Davids, J K Simons.

SOUTHERN REGION

Northern Piedmont Section

Senior

Sterling F Watts Jr—Head finisher, Burlington Finishing Co, Div Burlington Industries, Inc, Dublin, Va.

Associate

Robert H Almon—Training program, Proximity Print Works, Cone Mills, Inc, Greensboro, NC.

Transfer to Senior

Frank J Anderson Jr—Salesman, Refined Products Co, Charlotte, NC. Sponsors: G H Fine, C Hooper.

Piedmont Section

Transfer to Senior

Thomas E Davis—Chief engr, Burlington Eng Sales Co, Inc, Graham, NC. Sponsors: A H Gaede, W G Parks.

Associate

Robert N Lowery—Laboratory asst, Burlington Mills, Cramerton Mills, Mayflower Plant, Cramerton, NC.

South Carolina Section

Senior

Philip B Hudson—Technical salesman, Laurel Soap Mfg Co, Greenville, SC. Sponsors: A H Gaede, H J Jordan Jr.

Transfer to Junior

Ralph E Sims—Development chemist, The Kendall Co, Bethune, SC. Sponsors: L A Stanley, W L Mathias.

Robert L Ward Jr—Asst overseer of dyeing, Excelsior Finishing Plant, Pendleton, SC. Sponsors: G M Kidder, G J Mandikos.

Southeastern Section

Senior

Sidney L Vail—Organic chemist, U S Dept of Agr, Southern Utilization Research & Dev Div, New Orleans, La. Sponsors: J D Reid, R M Reinhardt.

Jack P Haunson—Dev chemical engr, Tennessee Corp, Atlanta, Ga. Sponsors: R E Smith, W E Tiller.

Junior

George W Butler—Chemist, Eagle & Phenix Div of Reeves Bros, Columbus, Ga. Sponsors: L Tigler, H J Gambert.

Transfer to Junior

John R McCulloch—Production trainee (dyehouse), Riegel Textile Corp, Trion Div, Trion, Ga. Sponsors: W D Inabnit, R R Stewart.

Washington Section

Senior

Lawrence R Blake—Senior dev engr, Celanese Fibers Co, Amcelle Plant, Cumberland, Md. Sponsors: F Fortess, G C Ward.

WESTERN REGION

Mid-West Section

Student

Jeannette A Spangler—Student, Purdue Univ, West Lafayette, Ind. Sponsor: R W Padgett.

Transfer to Senior

Alastair W Hunter—Tech service lab supv, National Aniline Div, Allied Chem Corp, Chicago, Ill. Sponsors: E J Sindt, E L Miller.

William G Paul—Tech rep, Harchem Div, Wallace & Tiernan, Belleville, NJ. Sponsors: E Morrill, J E Miller.

(*concluded on page 48*)

Elected to Membership†

NEW ENGLAND REGION

Northern New England Section

John B Baker
George Blyth Jr
Eli Heimberg
Richard W Lord
Jim Marsden
George A Mayne
Arthur M Tracy (J)
Albert Meilink (S)

Rhode Island Section

George C Huse
Terry H Trimmer
Laurie L Whitford
Rene J Chaput (J)
Anthony F Gallonio (J)

Western New England Section

Francis P Tolka
Anthony Mauerer
Sidney Scheinkman

CENTRAL ATLANTIC REGION

Delaware Valley Section

Alfred J Banford
Patrick V Bonsignore
Samuel L Cassedy
Jack J Cram
Miles B Dahlen
Norman G Diggins
William A Fuchswanz
Frank J Grano
Charles E Harrison
Donald M Jones
Milton C Keen
Richard J Palestri
Donald S Renshaw
Paul W Saylor
Edward F Silk
Matthew F Tarde
Alden R Taylor Jr
Walter W Thomas
Philip Wehner
J Bertram Bates (A)
Nicholas B Hill (A)
*William H Brehm II**
*Emery I Greschler**
*Robert E Miller**

Hudson-Mohawk Section

Marcel J Touponse Jr

Metropolitan Section

Charles B Beiter
Giorgio Binda
Martin Blakeman
Samuel Blumrosen
Roger A Calsibet
Raymond J Fallon
Frank H Foxlee
Ernest P Gecz
Charles A Meier
Joseph A Ramp
John E Sherman
Sam S Sinatra
Stanley S Slowata
Raymond L Sweet
Gunter Thiel
Waldo Trescott
Peter Van Vlaanderen
Ed J C M Van Wely
Abraham R Young
A B Hestwood Jr (A)
Jack H Lilburn (A)
John V Lyons (A)
Harold W Rose Jr (A)
Michael A Torres (A)
Lawrence W Healy (J)
*Guy A Baldecchi**
*John L Mercer**

Niagara Frontier Section

Edward Johnson
Hugh M McGarrey

SOUTHERN REGION

Piedmont Section

Griffin N Alford
Edmond P Bebeau
Ervin Bolgar
George L Brodmann
Otto C Burrell
Lawrence T Carter
Thomas M Dalrymple
Ross R Fowler
Lloyd E Franklin Jr
Constantin Ghionis
Winfrey T Martin Jr
Scott P Patterson
George L Payet
James M Perry
Joachim C Roehl
Edward B Wrike
Thomas E Davis (A)
Ralph E Petree Jr (A)
Joseph G Wright (A)
Bobby J Adams (J)
Francis C Mackey Jr (J)
William G Newsome Jr (J)
*Donald G Logue**
*A M Purut**

Southeastern Section

Morris M Bryan Jr
George C Daul
Terrence W Fenner
John S Moore
F M Wallace
Lawrence O Bublitz (A)
Donald E Jenkins (A)

Washington Section

S Helen Roberts
Mary L Walsh (J)
*Doris I Lyerly**

WESTERN REGION

Mid-West Section

Faber B Jones
Mary Lapitsky
Robert I Leininger
Alma F Tapscott
Barbara J Waters
John L Steen (J)
*James L Mattingley**

STUDENT CHAPTERS

Auburn University

Frank W Saunders Jr (S)

Bradford Durfee College of Technology

George E Quigley (S)

Clemson College

John B Neely Jr (S)

North Carolina State College

Montague H Hicks Jr (S)
Allen N James (S)
Wesley O McGee (S)
Charles M Nifong (S)
Elizabeth A Satterwhite (S)
Douglas E Walton (S)

Philadelphia Textile Institute

Arnold M Bernstein (S)
Alexander G Burgess Jr (S)
Robert T Cavis (S)
Kerst S Deboo (S)
James G Freas (S)
Haim Goldman (S)
Edward F Levine (S)
Gerland C Liberace (S)
Edward A Lisewski (S)
John E Salidis (S)
Randall S Sword (S)
Lee L Tompkins (S)
Clement Shau-chi Tung (S)

NOT AFFILIATED WITH A SECTION

Alfredo Behrens
Edward D Duffin
Henkrik Goorhuis
Yasuo Hara (A)
Miura Hatsuo (A)
*Mahendra K Shah**

†No designation indicates Senior; A—Associate; J—Junior; S—Student; asterisk—transfer from another class of membership

Membership Applications——

(concluded from page 47)

Pacific Southwest Section

Senior

William L Lyons—Sales mgr of the Los Angeles Office, Koppers Co Inc, Chem & Dyestuffs Div, Los Angeles, Calif. Sponsors: R A Fliegel, D D Sanders.

STUDENT CHAPTER
New Bedford Institute of Technology

Student

Onil Jean-Claude Couture—Student, New Bedford Institute of technology, New Bedford, Mass. Sponsor: F Tripp.

NOT AFFILIATED WITH A SECTION

Transfer to Junior

Gaston Plante—Asst chemist, Paton Mfg Co Ltd, Sherbrooke, Quebec, Canada. Sponsors: E S Skrutkowski, G M Kidder.

Edmund O Pua—Chemist, Derby Co, & Nyanza Chem & Color Co, Lawrence, Mass. Sponsors: G M Kidder, G J Mandikos.

Future Papers

THE following papers have been submitted for publication in future issues of the Proceedings:

"Construction Limits of Fabrics Containing Creslan Acrylic Fiber"—H C Haller, American Cyanamid Co

"The Monforts Reactor—A Versatile Continuous Dyeing Machine for Synthetic Fiber Fabrics"—Fred Fortess, James E Torbet, George C Ward, and Joseph S Warner, Celanese Fibers Co

"Dyeing and Finishing of Manmade Fibers in a Cotton Finishing Plant"—Heyward V Simpson, Reeves Bros, Inc

"Science and Craft in Color"—Panel

"The Dyeing of Acrilan 16 and Acrilan 16/Acrilan 1656 Blends"—Walter Stump, The Chemstrand Corp

"Modern Continuous Dyeing Processes"—Richard Kern, Sandoz Ltd

"Rovana—Versatile New Yarn"—Charles R Sheehan, Dow Chemical

"Reducing the Felting Shrinkage of Wool"—Fred H Steiger, Rohm & Haas Co

"The Importance of Odor Control in Textile Processing"—Breckenridge K Tremaine, Rhodia Inc

"Fabric Development from a Practical Dyer's Standpoint"—James Greer, Greensboro Finishing Co, Burlington Industries

"A Study in Union Dyeing"—Northern New England Section

"Selection of Direct Dyestuffs for Application to Undesulfured Rayon Staple"—Southeastern Section

"Dyeing with Vinyl-Sulfone Reactive Dyes"—H Luttringhaus, Carbic-Hoechst Corp

"Status of Nonwoven Fabrics in the Textile Trade"—Howard W Shearer, American Viscose Corp

"New Fibers from DuPont"—Milton M Christie, E I duPont de Nemours & Co, Inc

"Recent Developments in the Dyeing of Verel Modacrylic Fiber"—R J Fortune, Tennessee Eastman Co

"New Color-Measuring Instruments for Use by the Textile Industry"—F J Rizzo and A O Ramsley, Quartermaster Research and Engineering Command, U S Army

"The Application Principles of Acrylic Backcoating" — Charles E Hoey, Rohm and Haas Co

"Dyeing Zefran Acrylic Fiber in Blends"—F M Rawicz, Dow Chemical Co

"American Standard Performance Requirements for Textile Fabrics"—Ephraim Freedman, Macy's Bureau of Standards

Activities of the Local Sections

Hudson-Mohawk

APPROXIMATELY 38 members and guests attended the November 18th meeting of the Hudson-Mohawk Section held at the Chelsea House, Tribes Hill, NY.

Speakers were John Cronwell, technical director, and John H Karrh, general manager of the Plastics Division, Reeves Bros, Inc. In discussing polypropylene fiber, Mr Cronwell spoke on the physical properties, and Mr Karrh spoke on the present method of dyeing. A question-and-answer period followed the talks.

•

Northern New England

A panel of prominent authorities in textile finishing will lead a symposium on this subject at the January 20 dinner meeting of the Northern New England Section to be held at Motel 128 in Dedham, Mass. The panel speakers and the areas each will cover as a part of the program are as follows:

Werner von Bergen, associate director of research, J P Stevens and Co, "Chemical Finshing of Wool and Wool Blended Fabrics".

Donald D Gagliardi, president and research director, Gagliardi Research Corp, "Chemical Finishing of Cellulosic Fabrics".

John J McDonald, professor of textile dyeing and finishing, Lowell Technological Institute, "Mechanical Finishing of Textile Fabrics".

The discussion is to be initiated by questions from the audience.

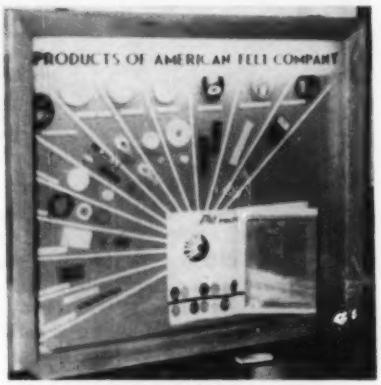
•

Western New England

SEVERAL displays by textile manufacturing firms in the area highlighted the December 2 meeting of the Western New England Section at Rapp's Restaurant, Shelton, Conn. Vice Chairman Timothy J Horan, Princeton Mills, arranged for the displays by American Felt Co, American Fabrics Co, Princeton Mills, Cheney Bros, Housatonic Dyeing & Printing Co, Heminway & Bartlett Mfg Co, Bigelow Sanford, United Elastic Corp, Hartford Fibres Co, and National Felt Co.

Representatives of these firms who were present gave short talks about the products manufactured by their firms. Thomas J Gillick, representing American Felt Co, spoke on wool and felt manufacturing. Burton C Wink-

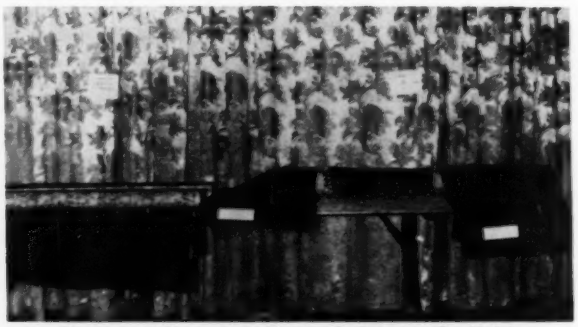
WNE OFFICERS FOR 1961—L to r: Burton C Winkler, American Fabrics Co, treasurer; Albert H Rant, Laurel Soap Mfg Co, Inc, chairman; Timothy J Horan, Princeton Mills, vice chairman; William H Espelin, Ciba Co, Inc, secretary



American Felt Co display

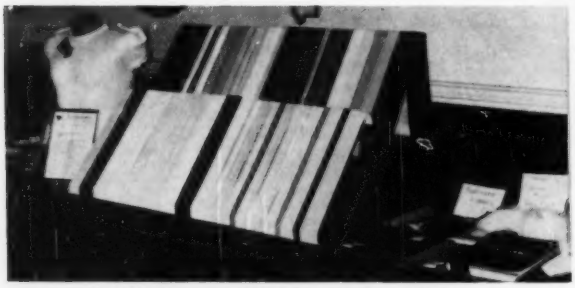
Displays of Princeton Mills (left) and American Fabrics Co (right)

WNE OFFICERS, COUNCILORS, AND SECTIONAL COMMITTEE—Seated, l to r: William H Espelin, Ciba Co, Inc, treasurer; Timothy J Horan, Princeton Mills, vice chairman; Albert H Rant, Laurel Soap Mfg Co, Inc, chairman; Burton C Winkler, American Fabrics Co, treasurer. Standing, l to r: Arthur Bibeau Jr, American Felt Co, sectional committeeman; Thomas J Gillick Jr, American Felt Co, Councilor; Andrew W Goodwin, Princeton Mills, Councilor; Gregory J Pelliccione, Princeton Mills, sectional committeeman; Joseph A Black, American Cyanamid Co, sectional committeeman. Alexander H DeMarco, Shelton Hosiery Mills, Inc, sectional committeeman, was not present when photo was taken.



Displays of Housatonic Dyeing & Printing Co (left) and Cheney Bros (right)

Bigelow Sanford display—rugs, Crestliner fiber glass boats



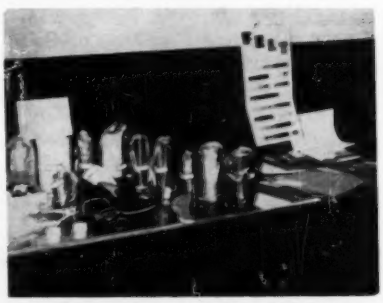
Displays of United Elastic Corp (left) and Hartford Fibres Corp (right)

ler, representing American Fabrics Co, titled his talk "The Lady in Lace". John Bridgeman, representing Princeton Mills, discussing new ideas and new developments to make modern industry prosper, spoke chiefly on napped knitted goods. Peter Dubiel, representing Cheney Bros, described in some detail the velvets, plushes, and jacquards manufactured by his firm. Flavio Vagnini, Housatonic Dyeing & Printing Co, discussed commission dyeing and printing of piece goods. Mark Pettit, representing Heminway & Bartlett Mfg Co, discussed the manufacture of sewing thread, braiding, and the throwing, dyeing and finishing of threads and laces.

The other firms did not have representatives present, but Mr Horan undertook to call attention to their displays and then urged the entire audience to examine the displays and have informal discussions with the various company representatives.

The idea was well received by the audience of approximately fifty members and guests, and Mr Horan was given a rising vote of thanks.

WNE Chairman Albert H Rant urged all present to prepare for the New England Regional Meeting to be held at the Jug End Barn, South Egremont, Mass, May 5-6.



Heminway & Bartlett Mfg Co display—threads, lacings, etc (left); National Felt Co display (right)

Another new development using

B.F.Goodrich Chemical *raw materials*

New excitement, new color, new wear for fabrics is sprayed on with Geon

Here's a new and simplified method for applying decorative patterns and textures to textiles. It's a low-cost spraying technique using Geon vinyl latices and plastics and developed by B.F.Goodrich Chemical Company. Standard spray equipment is used to produce spatter and swirl patterns that approach the regularity of printed designs—with no need for expensive engraved rolls.

At the same time, you can also produce a three-dimensional effect previously very difficult to achieve. Any combination of colors can be obtained. Also, fabrics get better durability and wear resistance. Versatile Geon vinyls make all these possible.

The decorated fabrics are extremely flexible, washable and dry-cleanable. In most cases, "hand" and feel are unaltered.

This low-cost decorative spraying technique with Geon vinyl offers design opportunities for other types of materials as well. Full information is available. Write Dept. PG-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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B.F.Goodrich Chemical Company
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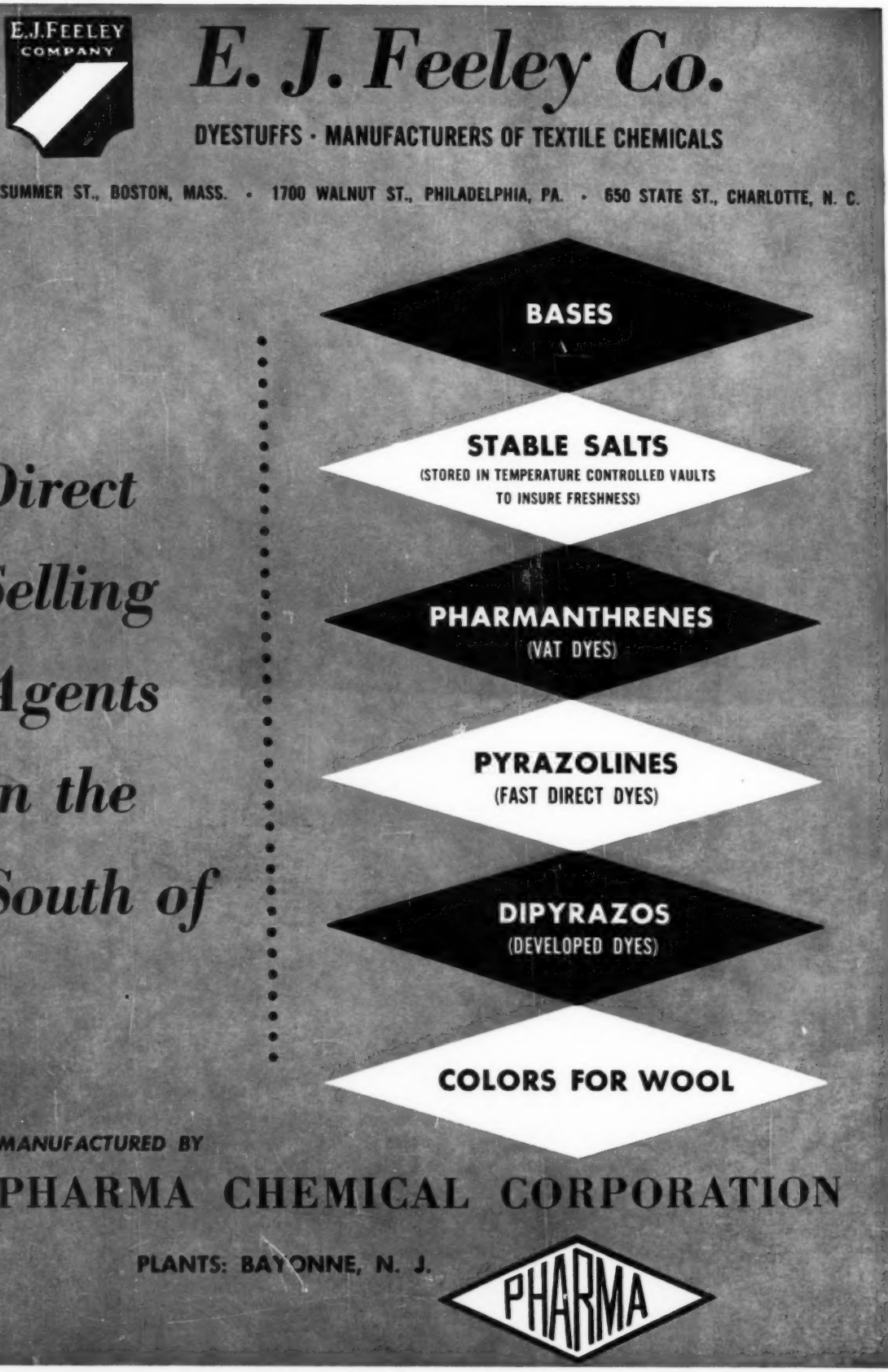
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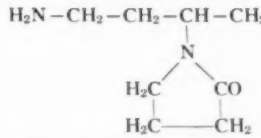
(STORED IN TEMPERATURE CONTROLLED VAULTS TO INSURE FRESHNESS)
PHARMANTHRENES
(VAT DYES)
PYRAZOLINES
(FAST DIRECT DYES)
DIPYRAZOS
(DEVELOPED DYES)
COLORS FOR WOOL
MANUFACTURED BY
PHARMA CHEMICAL CORPORATION
PLANTS: BAYONNE, N. J.
PHARMA

PIGMENT PRINTING PASTES——— Polymer Emulsions Plus Basic, Epoxy-containing Compounds as Binders (D,2,07)

U S Pat 2,903,436 (Farbenfabr Bayer—Lehmann et al—Sept 8, 1959)

U S Pat 2,780,562, copending with the present patent, describes a pigment printing process in which polymer emulsions together with high-molecular basic substances which may contain two or more reactive groups, eg, hexahydro triacrylyl triazine, were used as binders.

According to the current patent, particularly good effects reportedly result when such basic high-molecular weight compounds contain reactive epoxy-groups as polyfunctional cross-linking agents. Products of this type may be obtained by condensing polyamines with epihalohydrines, as decribed in copending U S Pat 2,844,490 [cf *Am Dyestuff Reptr 48*, 45/18 (1959)]. Appropriate polyamines are tetramethylene-diamine, N(1-6-hexamethylene diamino)-3-pyrrolidone



and other polyamines. (Cf col 1, lines 36-41).

The condensation of these basic compounds with the polymer emulsions can be interrupted by adding acid. The condensates are insolubilized by heating to 100°C whereby self-cross-linking occurs between the reactive epoxy- and amino-(or imino-) groups; at the same time they act as pigment binders. Among the advantages here are the relative volatility of the basic compounds and their rapid action. The inherent viscosity of the condensates is high enough to dispense with addition of other thickeners.

Example: The polymer emulsion contained styrene, acrylic acid butyl-ester and acrylic acid emulsified in solutions of alkali salts of long-chain paraffin sulfonates and paraffin sulfinates. After polymerization at 30°C, the latex was mixed with an aqueous solution of the acetate of a basic polyurea, prepared from diethylene triamine, diamino propyl methylamine and hexane diisocyanate. Finally this mixture was stirred with basic epoxy polymer prepared from dipropylene triamine, epichlorohydrine and acetic acid, as the main ingredients, plus a red pigment paste. Prints on cotton dried at 80°C reportedly gave bright red effects of very good fastness to crocking, light and boiling in soda ash solution.

References cited by the Patent Office:

U S Pat 1,977,252 (Du Pont/1934): condensates of epichlorohydrine and water-soluble primary amines are used for improving the depth of shades of vat prints.

U S Pat 2,780,562 (Farbenfabr Bayer/1957): see above.

●

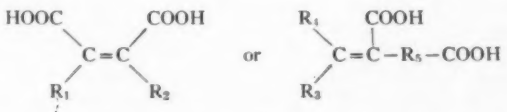
ANTISTATIC COMPOSITION——— Polyesters of Dicarboxylic Unsaturated Acids (G,1)

U S Pat 2,901,451 (Deering Milliken Res Corp—Gagarine, Repotkis—Aug 25, 1959)

In contrast with many standard antistatic agents, the composition protected by the current patent is claimed to be reasonably durable both to washing and drycleaning. Another advantage is that the patented composition is water-soluble, thus easily applicable by conventional methods, and it may be transformed into an insoluble compound by simple exposure to air without requiring a heat curing process.

According to this patent, a resinous antistatic composition of the above qualities is prepared by esterifying a polyglycol with a dicarboxylic unsaturated acid. Polyglycol compounds employed in this reaction have the general formula $H(OR)_x—Z—(RO)_yH$ wherein "R" is lower alkylene and the sum of "x" and "y" is between 3 and 150 (preferably 12-40). "Z" is a divalent radical comprising O-R—O or a substituted imino-group. Best results were obtained with polyethylene glycol esters of mol weight 700-1200.

Dicarboxylic unsaturated acids correspond to the formulas



wherein "R_1" and "R_2" are H or alkyls up to 7 C, "R_3" and "R_4" are H or lower alkyls, and "R_5" stands for $—CH_2—$ or $—C_2H_4—$. Examples are maleic, dibenzyl-maleic acids etc (cf col 2, lines 19-25) or anhydrides thereof. Maleic anhydride is the reactant preferred. Ratios of the ester components may vary between one and 20 mols acid and one and two mols polyglycol. In the latter event, higher condensation temperatures are employed whereby the polyglycol compound is believed to cleave and form a larger amount of esters with the single acid groups (cf col 1, line 52—col 2, line 39). It is also possible to replace a large part of the costly unsaturated acids by saturated ones, eg, phthalic anhydride or adipic acid. Adding an esterifying catalyst such as sulfuric acid is favorable. This reaction should be conducted until the polyester reaches a high mol weight, preferably above 6000. More satisfactory results have been obtained by adding a polymerizable vinyl compound (styrene, vinyl acetate) plus a polymerization catalyst (persulfate) to speed the transformation of the resin into insoluble state. Other additions reportedly increase the fastness to washing, eg, quaternary ammonium chloride or boric acid (cf col 4, line 21—col 5, line 70).

Example: Polyethylene glycol (Carbowax 1000) was esterified with maleic anhydride at 200°C in the presence of sulfuric acid to give a polymer of approx m w 6000, solidifying at 25°C. Four pbw of this product were dissolved in 200 p water. A 100% Dacron fabric was padded in this solution to a wet pickup of 65% and dried at 250°F on a tenter frame within 25 seconds. Good antistatic properties were observed; the effect became durable to washing and drycleaning after 10 days aging.

Among the references cited by the Patent Office:

U S Pat 2,195,362 (Ellis Foster Co/1940) describes an insoluble and infusible composition prepared by condensing maleic, fumaric, etc acids with a glycol in the presence of an acid catalyst.

US Pat 2,628,176 (Chicopee Mfg Co/1953): synthetic

fibers are rendered astatic, ie, unable to develop static electricity, by impregnation with a hexitol partial ester, eg, sorbitan monolaurate or ethylene oxide condensates thereof. [Cf *Am Dyestuff Reptr 43*, 53 (1954)].

●

FLOCK FABRIC Ornamented with Printed Patterns (D,4)

U S Pat 2,901,373 (Heberlein Pat Corp—Weiss—Aug 25, 1959)

A fabric uniformly covered with a flock may be printed in certain areas with a thickened solvent, which at least partly dissolves the flock while leaving the nonprinted areas unchanged. By proper adjustment of the solvent viscosity with an appropriate thickener, lateral flow of the solvent into adjacent, nonprinted areas is prevented. The solvent and the adhesive which binds the flock to the fabric have to be inert to one another; thus solution (or swelling) of the flock stops as soon as the adhesive layer is in contact with the print.

A printed flock fabric produced by the present method is illustrated in Fig 1; an enlarged section of a portion of the fabric is shown in Fig 2. The base fabric (12) is covered with an adhesive layer (13) which bonds the flock material (14). The thickened solvent paste for the flock is applied by printing to form pattern (15). The flock is at least partially dissolved and deposited in the form of an adherent film (16). Upon drying, the film (16) appears in most cases as a glossy surface, contrasting to the surrounding piles of the fabric.

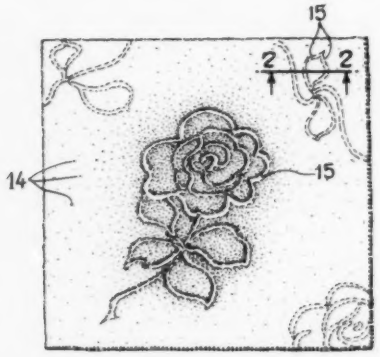


Figure 1

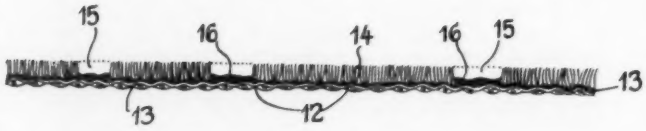


Figure 2

The solvent is selected according to the chemical character of the flock-forming fibers; eg, zinc chloride, calcium thiocyanate or sodium zincate, etc, for cellulose; acetone for cellulose acetate flock, etc. Thickening to the necessary viscosity (approx 180-400 cp) can best be accomplished by incorporating into the solvent a material chemically identical with that of the flock-fibers (cf col 2, line 48—col 3, line 28).

Example: A cotton fabric covered with viscose flock, bonded to the fabric by a natural rubber adhesive, was printed with a solution of 69% zinc chloride and 31% water and thickened with 2% rayon waste. The viscosity was measured at 243 cp. The printed fabric was dried at 90°C, washed with cold water and dried under tension.

Among the references cited by the Patent Office:

U S Pat 1,818,505 (Celanese Corp of Am/1930): A pile fabric, the back of which consists of wool or silk and the pile of acetate of cellulose, is printed with a paste that contains a mineral acid and a solvent (acetone). It is then dried and steamed, following which the carbonized threads are removed by brushing.

U S Pat 2,307,118 (Gen Aniline/1943): embroidered effects on fabrics composed of cellulose and cellulose derivatives or animal fibers are obtained by printing with organic sulfonic acids (eg, naphthalene sulfonic acid), drying, steaming and rinsing, whereby the cellulose portion is destroyed.

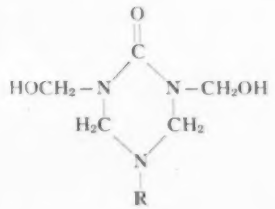
●

CREASE- AND SHRINK-RESISTANT FINISH———Combination of Ethylene Urea Condensates with Triazones (G,2,04)

U S Pat 2,901,463 (Rohm & Haas—Hurwitz—Aug 25, 1959)

The preamble to this specification discusses known disadvantages frequently observed in resin finishes, such as chlorine retention, consequent reduction of tensile strength, scorching upon ironing and discoloration. A combination of melamine-formaldehyde condensates with dimethylol ethylene urea has been patented in U S Pat 2,690,404 of Dan River Mills [cf *Am Dyestuff Reptr 45*, 148 (1956)] with the object of reducing the loss of tensile strength and discoloration when the fabric is so finished. Improvements by this method, however, are criticized in the current patent as insignificant.

According to the present patent, creaseproofing effects without the risk of discoloration, loss of tensile strength or development of bad odors (as encountered in triazone finishes) reportedly can be obtained. This is accomplished by combining at least 25 mol % and not over 75 mol % of a compound (Component B) of formula



wherein "R" is 2-hydroxyethyl, 2-methyl-hydroxyethyl or alkyl from 1-4 C (thus a triazone) with "Component A", ie, a condensate of formaldehyde with melamine, urea, ethylene urea or trimethylene urea (see col 2, line 65—col 3, line 9). According to most of the examples and claims, dimethylol N-N′-ethylene urea is preferred as Component A. Examples of triazones applied as Component B are listed in col 2, lines 42-64. Proportions of A and B are within the limits 70-50 to 30-50.

Acidic catalysts of the ammonium-salt or amine-salt type (see col 3, lines 34-47) may be added in a concentration of approx 1% of the aqueous condensate solution.

Example: Finishing compositions covered by the current patent contain varying proportions of dimethylol ethylene urea (Component A), dimethylol methyl tetrahydro-s-triazone (Component B), and a catalytic amount of ammonium chloride. Proportions of A:B tested were 1:3, 1:1 and 3:1. With the 3:1 proportion, superior results as regards dimensional stability, crease

(*concluded on page 68*)

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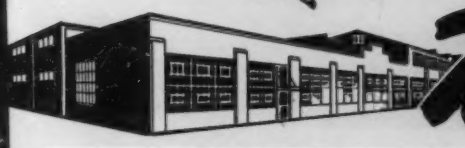

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ADR News Report:

General News of the Industry
Personnel
New Products, Developments, Processes

Columbia-Southern Now a Division of PPGC

Columbia-Southern Chemical Corp, a wholly owned subsidiary, became a division of Pittsburgh Plate Glass Co on January 1.

The new division will operate under the name of Pittsburgh Plate Glass Co, Chemical Division. The principal officers of Columbia-Southern Chemical Corp have been elected as officers of Pittsburgh Plate Glass Co. Joseph A Neubauer has become vice president and general manager, Chemical Division, and Chris F Bingham has become vice president-chemical sales.

The change in corporate structure was made to consolidate the operations of Columbia-Southern Chemical Corp with those of Pittsburgh Plate Glass Co. The general direction and management of the chemical operations will not be affected by this corporate change.

The Chemical Division will continue to market its products under the trade name "Columbia-Southern Chemicals." These products include chlorine, caustic soda, soda ash, solvents, silica pigments, chrome chemicals, and barium chemicals.

Plants of the new Chemical Division are located at Barberton, O; Corpus Christi, Tex; Natrium, W Va; Lake Charles, La; Bartlett, Calif; South Charleston, W Va; Jersey City, NJ; and Midvale, O.

Present subsidiaries of Columbia-Southern Chemical Corp have become subsidiaries of Pittsburgh Plate Glass Co. Mr Neubauer will continue as president of these subsidiaries.

Columbia-Southern Chemical Corp and predecessor companies have operated under the Columbia name since 1899.

•

ACMI President to Address AATT at Annual Meeting

J M Cheatham, president, Dundee Mills Inc, and currently president of the American Cotton Manufacturers Institute, will deliver the banquet luncheon address at the annual meeting of the American Association of Textile Technology on February 8, 1961 at the Hotel Commodore, New York. His subject will be: "The Impact of World Events on Fiber Technology."

This will be the first annual meeting of AATT since its reorganization last January to provide for the operation of chapters. The three chapters of the Association are New York, Piedmont and Appalachian. The theme of the meeting is: "The Challenge of Modern Fiber Technology."

The one-day conference-type program will be open to all members of the textile industry. It will explore the question of how to cope with the many problems raised by the flood of new man-made fibers and fiber modifications. 32 outstanding personalities from the textile industry, retailing and related groups will appear in four panels. The questions for the panels will be polled from registrants.

•

New Process for Odor Prevention in Resin-finished Goods

James Ullman, president, Blau Deodorizing, has been granted a patent pending on a new process for preventing odor in UF and MF resin-finished goods.

The process does not include the use of masking agents. Application of the process is in the ager or other similar equipment on a gas principle. It is recommended that the process be employed at the mill immediately after curing, although it reportedly can be applied as well to goods which have been in storage.

Mills interested in licensing arrangements or further information should contact Mr Ullman at 516 Fifth Ave, New York 36, N.Y.

•

Fabrics Redyeing by Hotels Cited as Top Aid in Attracting Guests

Pennsylvania hotel owners were told last month that the redyeing of draperies, linens and other fabrics is of prime importance in brightening establishments and attracting guests in the highly competitive hotel industry.

In an address before the Pennsylvania Hotel Convention at the Hotel Brunswick, Lancaster, Pa, Burton M Halpern, information director of Garment Dyers Guild of America, stated that the mushrooming of luxurious motor lodges around the country presented a challenge to operators of established hotels to freshen up their decor to meet this new competition.

Pointing out that the nation's dyeing industry "is at the apex of its technical excellence," Mr Halpern urged hotelmen to take advantage of the redyeing process in three major areas in both large and small hotels:

1) Draperies in both private guest rooms and public spaces.
2) Carpeting, bed linens, bedspreads and towels in guest rooms.
3) Tablecloths, napkins and employees' uniforms in dining rooms.

Mr Halpern, a public relations executive and partner in the New York firm of Freeman/Halpern Associates, claimed that redyeing offered the hotel industry the least expensive form of redecorating.

Pointing effective uses of redyeing, Mr Halpern noted that many hotels buy plain white linen and have it dyed to shades of their own selection.

•

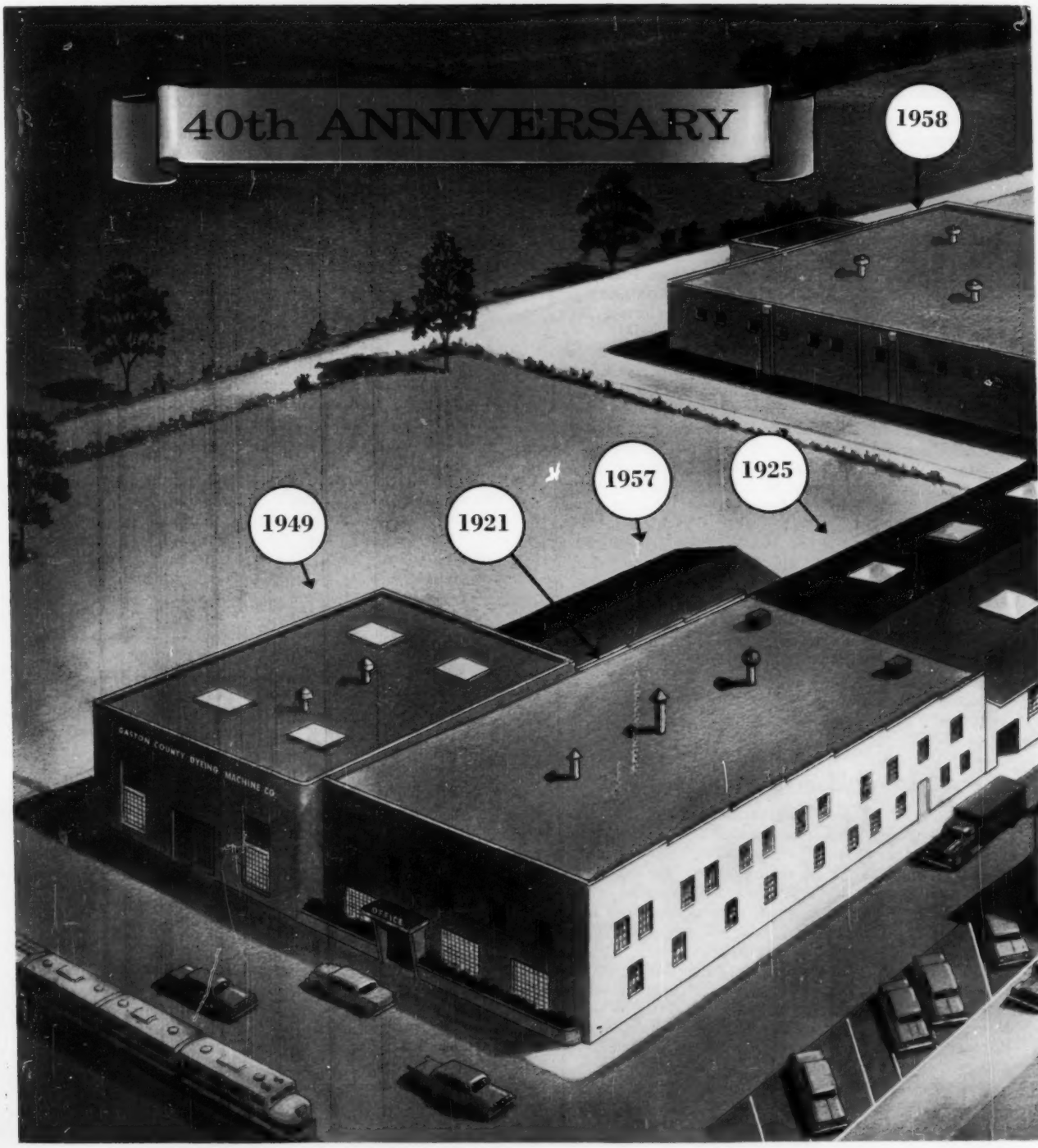
1961 Plant Engineering & Maintenance Show

Each year, the Plant Maintenance & Engineering Show grows in significance, scope and size. The 1961 show is expected to be no exception, as every industry reaches out for more mechanization, more automatic controls and higher speeds.

The exhibits reportedly will be of unprecedented variety and scope and there will be many innovations in the accompanying Plant Maintenance & Engineering Conference, also in its twelfth year.

Special "problem sessions" have been arranged for those interested in textile, chemical, and electronic equipment plants. The general sessions will give greater emphasis to the managerial aspects of maintenance in order to bring them into balance with the technical side.

The show, and the morning sessions of the conference, will be held at the International Amphitheatre, Chicago. Evening conference sessions will take place at the Palmer House. The dates are Jan 23 through 26 for the show; the conference ends on Jan 25.



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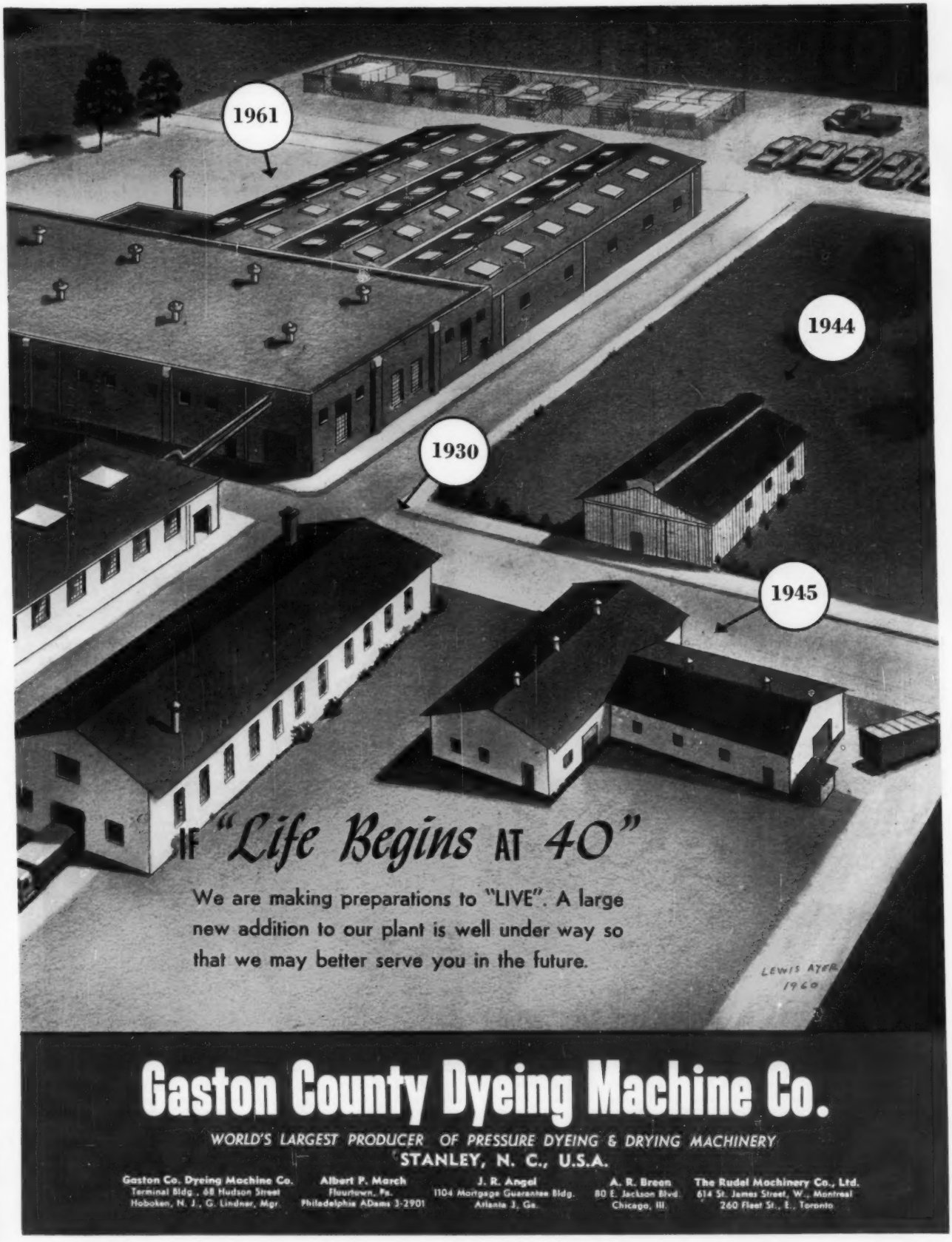
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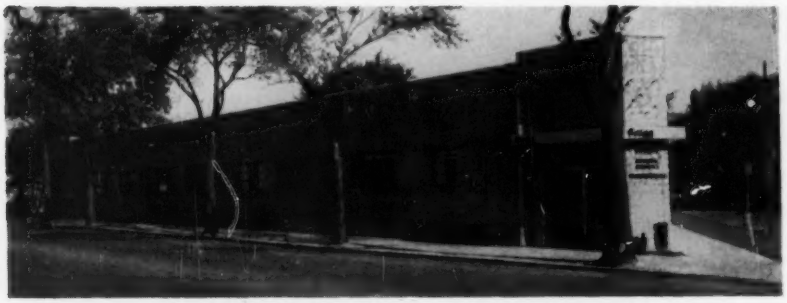
Geigy Dyestuffs' Chicago Facilities Expanding

With finishing touches completed on new and expanded facilities, Geigy Dyestuffs, Division of Geigy Chemical Corp, 5677 North Northwest Highway, Chicago 46, Ill, recently celebrated with an Open House.

Some one hundred fifty customers and friends enjoyed a buffet luncheon, featuring steaks, charcoal broiled in the "open-hearth" laboratory.

Geigy Dyestuffs first opened its Chicago branch in 1946, when space was at a premium, in loft quarters west of Chicago's Loop. For fourteen years this location served as Geigy's Midwest "home", with expansion of the Company's business finally making a move mandatory. The new branch office is a tan brick, one-story, air-conditioned corner building on Chicago's northwest side, comprising some fourteen thousand square feet of office, laboratory and warehouse space. The laboratory is equipped to provide technical service to the textile, leather and paper industries in the Midwest, to which Geigy Dyetuffs is a supplier.

Warren B Broadbent is Geigy Dyestuffs' Branch Manager in Chicago.



Geigy Dyestuffs' Mid-West Branch Office, Chicago, Ill

L to r: Richard Hauser, Milwaukee Dye & Bleaching Co; Charles H Sillin, E L Mansure Co; Frank Mialkowski, John Picken, and Thomas Spanley, Western Felt Works

Victor Schutz, Milwaukee Dye & Bleaching Co; Herman L Steen, Geigy Dyestuffs; William O Fischer, Milwaukee Dye & Bleaching Co; Warren B Broadbent, Geigy Dyestuffs; Frank E Hempel, Milwaukee Dye & Bleaching Co; Philip E Gelzer, Geigy Dyestuffs

Chalmer E Worley, The Orr Felt & Blanket Co; Mrs Warren Broadbent; A A Gorski and Gerald H Brown, Morgan Dyeing & Bleaching Co; Mrs Eugene Kopacz; Eugene Kopacz, Geigy Dyestuffs

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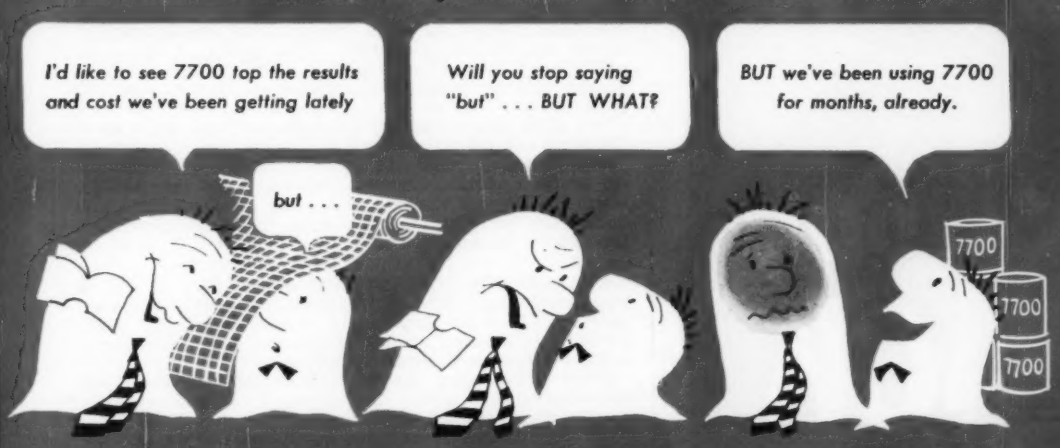
During a recent visit to the U S Department of Agriculture's Southern Utilization Research and Development Division, New Orleans, La, Harold Sagar (left), Manchester, England conferred with J David Reid on new finishing techniques for cotton. Mr Sagar is head of Section for Development and Utilization of Chemicals for Textile Finishing, Imperial Chemical Industries, Ltd. He was in the United States attending meetings on textile finishes and visiting various research centers. The Southern Division, where Dr Reid is in charge of Chemical Finishing Investigations, is the Department's center for cotton utilization research.

David E Dexter (right), Melbourne, Australia, conferred with Ralph J Brysson on weathering studies being conducted at the Division to prevent degradation of cotton textiles due to sunlight, mildew and fungi. Mr Dexter is manager of Brella Pty, Ltd, and was especially interested in the weathering studies as his firm is conducting research along the same lines. He was in New Orleans to attend the 47th Annual Convention of the Canvas Products Association International. Mr Brysson is in charge of the weathering studies being conducted at the Southern Division in cooperation with the Canvas Products Association International and the National Cotton Council.

These claims they make for Emersoft 7700 hand me a laugh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ADR TECHNICAL LITERATURE
(Available from sources in italics)

AQUATROL EXPANDER——*Industrial Roll Div, Rodney Hunt Machine Co, Orange, Mass*——A unique, new bow spreader roll is the subject of four-page Bulletin R-960. The design of the new roll reportedly embodies an entirely new principle of operation. With only one moving part—in contrast to the many moving parts of the conventional bow roll—the Aquatrol expander is said to operate with practically no friction. The single moving part is a rotating rubber sleeve that floates on a film of water. It is said to give uniform, smooth, even spreading action over every increment of face width.

In addition to describing the economic benefits and design features of the roll, the new bulletin incorporates a form for requesting a quotation on an Aquatrol Expander.

●

BECKMAN ZEROMATIC pH METER——*Technical Information Dept, Beckman Scientific and Process Instruments Div, Fullerton, Calif*——The Beckman Zeromatic pH Meter, a line-operated, drift-free instrument for making precise pH or millivolt measurements, is described in Bulletin 706-F.

The Zeromatic reportedly measures over the full 0 to 14 pH range and offers direct millivolt readings to ± 1400 mv.

The instrument, featuring push-button controls, also incorporates a standby circuit which eliminates the need for warm-up between measurements. The standby circuit also disconnects the glass electrode from the input, preventing polarization of the electrode.

●

CHANGE FOR THE BETTER——*Sandoz, Inc, 61-63 Van Dam St, New York 13, NY*——"Change for the Better" makes much of the data on the subject of coloring paper available in a single volume. It indexes dyes, encountered in the trade, from all major manufacturers.

There are sections in the new booklet to cover the following topics:

1) "Plus-Value" dyes for paper.
   Each dye, coded; plus its *Colour Index* number.
2) Specialties for papermakers.
   Sandoz dyes with no prototype, and dyes with special uses.
3) Dyes for stock.
   Colors recommended for use in the beater, pulper, etc.
4) Dyes for surface application.
   Specific recommendations for calender staining, etc, with solubility limits indicated.
5) Information on paper dye performance.
   Affinity for clay, side-properties, optimum pH, etc.
6) For specific paper grades.
   Specific recommendations for specific grades.
7) For your convenience.
   A ready-reference listing of dyes used in the trade.

●

COCONUT FATTY ACIDS——*Armour Industrial Chemical Co, Public Relations Dept, Chicago 90, Ill*——A new booklet, covering caprylic, capric, lauric and myristic acids, stripped and distilled coco acids and a capric-myristic blend.

The booklet provides specifications of the above Neo-Fats and their compositions as determined by gas chromatography.

●

COINING CHEMICAL WORDS——*The Cheminform Institute, 10 Columbus Circle, New York 19, NY*——The coining of names for chemical and allied products is the concern of many whose function it is to build good will and customer acceptance.

This paper, read recently before the Chemical Marketing and Economics Division of the American Chemical Society, gives details of methods and certain pitfalls that are to be avoided.

●

COLORMASTER DIFFERENTIAL COLORIMETER——*Manufacturers Engineering & Equipment Corp, York Rd & Sunset Lane, Hatboro, Pa*——Four-page illustrated Bulletin CM-1200 offers description, features, applications and specifications of the Mecco Colormaster differential colorimeter. Data Sheets DS-1210, DS-1220, DS-1230, and DS-1240 cover accessories.

●

FABULITE——*Product Service Dept, Stowe-Woodward, Inc, Newton, Mass, Neenah, Wis or Griffin, Ga*——A roll

covering for special and general applications in the textile and miscellaneous areas is described in this catalog page. Advantages, properties and recommended applications are listed in the technical data on the sheet. Typical applications for Fabulite rolls are: guider rolls, pad rolls, bleachery squeeze, fulling mill and narrow fabric processing.

●

1961 FIBER FACTS——*Product Information Office, Public Relations Dept, American Viscose Corp, 1617 Pennsylvania Blvd, Philadelphia 3, Pa*——In addition to an expanded glossary, denier conversion tables, and current data on Avisco's personnel and products, this pocket-sized textile digest contains a broad explanation of the Avisco Integrity Tag Program and a 22-page "Guide to Man-made Fibers."

Based on the Man-made Fiber Products Identification Act, the "Guide" includes Federal Trade Commission fiber definitions, a table of physical properties, and a summary of characteristics and end-use applications for each generic fiber classification as well as a listing of fiber trademarks and producers.

●

GIBBS DYEBATHS——*Gibbs Machine Co, Inc, PO Box 1323, Greensboro, NC*——This 14-page illustrated booklet contains technical and price information on the basic dyebath units and services for dyebaths furnished by Gibbs Machine Co, Inc. These include dyebaths for hand stirring, mechanized dyebaths, independent mechanized agitator, customs services, and accessory equipment.

●

HIGH-PRESSURE ACETYLENE DERIVATIVES——*Acetylene Chemicals Dept, Antara Chemicals, a Division of General Aniline & Film Corp, 435 Hudson St, New York 14, NY*——Ready-reference data sheet #AP-60-3 covers all of the company's commercially available high-pressure acetylene derivatives.

Each of these products, which include PVP, PVP/VA copolymers, PVP-iodine, vinylpyrrolidone, methylpyrrolidone, 2-pyrrolidone, butyrolactone, 1,4 butanediol, butenediol, butynediol, and propargyl alcohol and halides, are described in considerable detail. Chemical structures, physical forms and descriptions are given, as well as a listing of properties and uses.

The publication was produced on a three-page fold-out, suitable for bulletin board as well as file use, in red and black on white background.

●

INDANTHRENE DYESTUFFS ON COTTON PIECE GOODS——*#GDC-351T, General Dyestuff Co, a Division of General Aniline & Film Corp, 435 Hudson St, New York 14, NY*——A comprehensive treatise on the latest vat-dyeing techniques for cellulosic fibers.

Primarily concerned with the company's Indanthrene Dyestuffs on cotton piece goods (the title of the publication), this 120-page publication, however, covers the complete field of vat-dye application.

The brochure treats the application, properties, and uses of the company's Indanthrene vat dyes on cellulosic piece goods, discussing 70 different vat dyes within this classification. Six additional Algol, Hydron, and Brilliant Indigo vat dyes, not under the Indanthrene trademark, are also described. Even though they do not meet the fastness and standards of the Indanthrene line, other advantages such as brightness of shade or economy and high wetfastness prompted their inclusion in this publication.

In addition to complete descriptions of techniques, formulations and the methods involved, the brochure carries dye property tables and a complete vat dye index with both company trade names and *Colour Index* generic names and numbers.

●

L&N CONDUCTIVITY MONITOR——*Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa*——Four-page data sheet E-95(3) describes two new transistorized, continuous indicating conductivity monitors. Installation connections for conductivity measurement systems, circuit diagram, and pertinent features are described for two types of monitors: industrial model and portable model. Also included is a table listing available conductivity ranges and types of assemblies for automatic temperature compensation.

●

LaPINE APPARATUS REVIEW 12——*Arthur S LaPine & Co, 6001 South Knox Ave, Chicago 29, Ill*——Sixteen-page LaPine Apparatus Review 12 announces many new laboratory instruments: spectrophotometers, pH meters,

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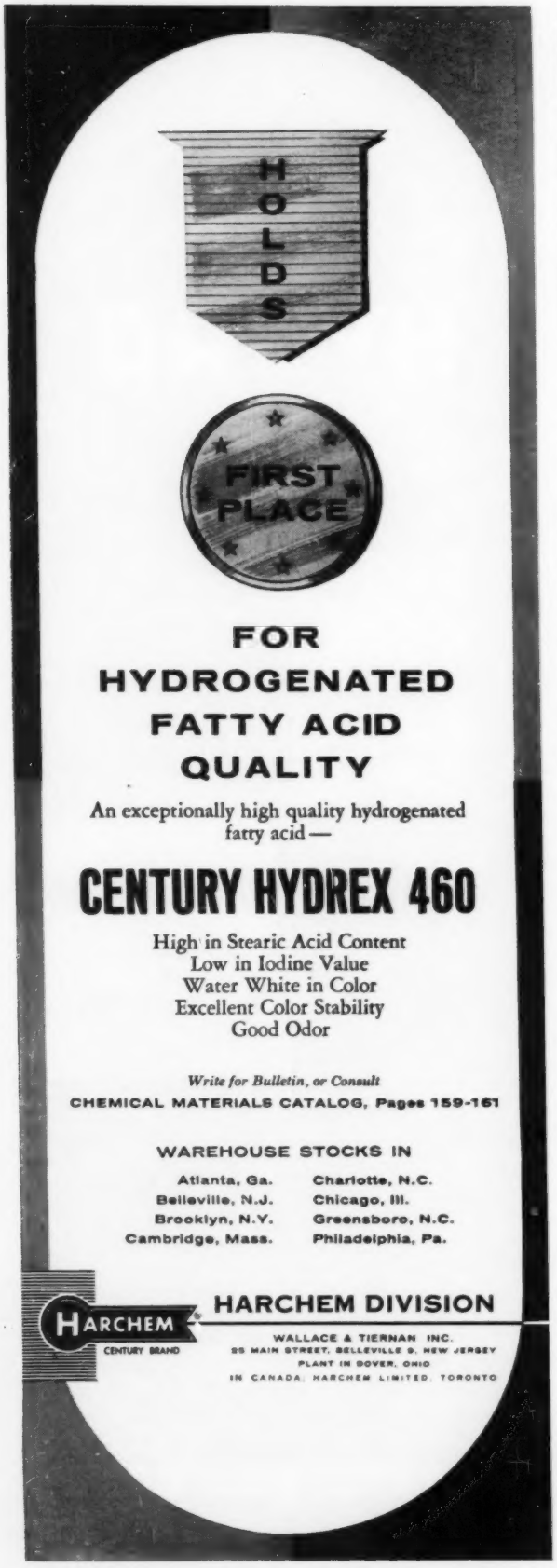


electrobalances, recorders, and related equipment.

In this issue, the Company announces a new distributorship: Coleman Instruments. Several pages are devoted to Coleman Metrion pH meters, junior spectrophotometers, nitrogen analyzers, and autofillers.

Apparatus Review 12 offers two spectrophotometers in the visible/ultraviolet range: Bausch & Lomb Spectronic 505 recording spectrophotometers, and Beckman Model DB spectrophotometers.

Many new Beckman instruments are listed: hydrogen flame detector for GC-2 gas chromatographs, Model 72 pH meters, Model 76 expanded scale pH meters, pH assemblies, and constant temperature blocks.

Review 12 introduces two laboratory recorders: a Leeds & Northrup strip chart recorder adapted for laboratory bench-top use, and a new Yellow Springs Instrument Model 80 recorder.

Two Cahn Electrobalances are described: the new RM automatic and an adjustable range model.

For chromatography, new Hamilton gas-tight syringes are shown, and Reeve Angel Amberlite ion exchange resin-loaded papers and Whatman cellulose ion exchangers.

Among the new items catalogued in this issue are Pyrex brand separatory funnels with Teflon plug stopcock, laboratory tensile and compression test machines, a steam distillation apparatus for the determination of fluorine, micro size hot plates, stepless input controllers, large hot plates with variable temperature control, heated vacuum desiccators, and flexible glove cabinets.

Popular items of laboratory equipment described in detail include Leybold high vacuum pumps with gas ballast device, micro sample splitters, LaPine wide-range clamps, LaPine Yellow Flash thermometers, gelation timers, safety ignition units for burning organic samples, pyrometric crayons, tablets, and liquids, plastic bottle carriers, glass-blowing burners, and other popular LaPine laboratory specialties.

●

LATEXES OF THE DOW CHEMICAL COMPANY——*Plastics Sales Dept, The Dow Chemical Co, Midland, Mich*——Brochure lists all The Dow Chemical Company's sales latexes, their properties, and typical areas of use. Styrene-butadiene polystyrene, vinyltoluene-butadiene, saran, vinyl, and acrylic latex families are included. Textile, paint paper, and building product use areas are emphasized. Twelve pages, pocket size.

●

LOGWOOD AND ITS APPLICATION——*The West Indies Chemical Works Ltd, 70 Wall St, New York 5, NY*——This series of articles, reprinted from *The Dyer & Textile Printer*, was presented by the technical staffs of the West Indies Chemical Works Ltd, the British Dyewood Co, Ltd, and the Yorkshire Dyeware and Chemical Co, Ltd, with O Newsome as general editor.

The articles appear under the following titles: I—Queen Elizabeth's Statute: Development of Mordanting Methods: Preparation of Extracts and Hematine Crystals; II—Dyeing of Wool on Chrome Mordant: Iron Mordanting; III—Dyeing of Natural Silk: Traditional Processes Still Used to Produce Blacks Unequalled in Richness; IV—Dyeing of Nylon and Acetate Rayon: After-chrome Methods on Winch or Jig: Chrome Mordant Process for Nylon; V—Minor Textile Uses: Cotton, Linen, Jute Dyeing: Some Experimental Work on Wool-Ardil Blends: Printing Blacks; VI—Varies Nontextile Uses: Production of Blacks on Chrome Leathers: Fur and Feather Dyeing: Straw for Hats.

●

NALCO INDUSTRIAL CHEMICALS——*Nalco Chemical Co, 6216 West 66th Pl, Chicago 38, Ill*——A broad spectrum of cationic and nonionic surface-active agents, ranging from fatty nitrogen derivatives to polyether alcohols are described in a four-page Bulletin K6. Among other chemicals discussed are fatty imidazoline diamines, fatty amidomonoamines, fatty amidodiamines, quaternary ammonium chlorides, oxyalkylation products, and colloidal silicas. Physical characteristics of the chemicals and some of their uses are included.

●

ORGANIC SOLVENTS AND CHEMICALS——*Chemical Solvents, Inc, 60 Park Place, Newark 2, NJ*——A completely revised and redesigned 64-page booklet of chemical properties, formulas, and other information, this new edition, the second, follows several printings of the first edition, initially published in 1954.

In pocket size, it has been designed to provide quick and authoritative information on some 150 chemical products. In addition, there are tables providing formulas for de-

natured alcohols, temperature conversions and for gauging the contents of drums. A comprehensive index is included.

●

PROPERTIES AND USES OF ETHERS AND GLYCOL DIETHERS——*Union Carbide Chemicals Co, 270 Park Ave, New York 17, NY*——New 40-page booklet contains comprehensive data on ethyl ether, isopropyl ether, butyl ether, and 1,4-dioxane and glycol diethers; diethyl Carbitol, dibutyl Carbitol, and methyl ethyl Carbitol.

Included is information on physical properties; solubilities; constant-boiling mixtures; specification limits; test methods; storage, handling, and shipping; physiological properties; and selected literature references.

Ethers are solvents for alkaloids, dyes, fats, gums, oils, perfume oils, resins, and waxes.

The glycol diethers are solvents, coupling agents, and inert reaction media. They are plasticizers for cellulosic materials and water-soluble resins, leveling agents for textile and leather dyeing processes and photo-print flatteners.

●

RECREATION AND CLEAN WATER——*Public Health Service, US Dept of Health, Education, and Welfare, Washington 25, DC*——At a time when the demand for water recreation opportunities is growing rapidly, increasing pollution of rivers, lakes, and beaches is causing a shrinkage of suitable play areas throughout the United States, according to this leaflet issued in advance of the National Conference on Water Collution.

The Conference, called by Surgeon General Leroy E. Burney of the Public Health Service, was held in Washington, DC, December 12-14.

Citing recent examples of pollution crisis from all parts of the country, the leaflet says: "Waters long used for recreation no longer serve this purpose—effectively withdrawn from the national domain either by official edict or by public disdain."

The leaflet, titled "Recreation and Clean Water," was prepared by the special staff to the National Conference on Water Pollution and issued by the Public Health Service. Three other pamphlets already issued are titled "Clean Water—A National Resource," "Public Health and Clean Water," and "Fish, Wildlife, and Clean Water."

●

RESISTANCE OF CHEMSTRAND NYLON TO FLUORESCENT LIGHT AND SUNLIGHT DEGRADATION——*Dept TVS, The Chemstrand Corp, 350 Fifth Ave, New York 1, NY*——The Chemstrand Corporation has announced the introduction of a light-resistant factor for all Chemstrand nylon fibers including Cadon nylon multilobal yarn and Cumuloft nylon, continuous filament textured yarn. According to the company, the new R-factor included during yarn manufacturing substantially increases the resistance of the nylon yarns to degradation caused by sunlight or fluorescent light.

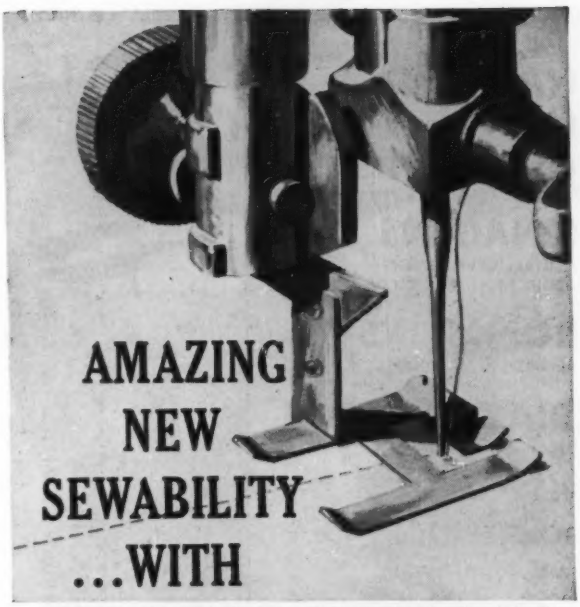
Chemstrand noted that, after thirty-days exposure, the light-resistant type Chemstand nylon lost only four per cent of its strength and two per cent of its elongation, whereas the older type yarn lost 35 per cent of its strength and 54 per cent of its elongation. The new R-factor, the company stated, is particularly important in plants where packages remain in creels for two weeks or longer, with stand-by packages in creels for from two to four weeks as is the case in many texturing, hosiery and other types of textile operations. These findings are confirmed by reports coming in from the trade, Chemstrand also revealed, where its R-factor nylon fibers have been used commercially for several months now.

●

ROTARY CUTTER-WINDER——*H W Butterworth & Sons Co, Bethayres, Pa*——New 4-page bulletin illustrates and describes completely automatic machine that operates in conjunction with seam detector, yardage meter, and pre-set yardage control. Shows typical winding set-ups. Reportedly saves the refinishing of up to 50 yards of material that may be soiled in completing one roll and beginning another.

●

SCREEN PROCESS EQUIPMENT——*American Screen Process Equipment Co, 2309 West Huron St, Chicago 12, Ill*——More than 1,000 items are presented for high-speed automatic production, for drying a wide variety of process printed materials, and for photographic needs. The line includes equipment of domestic and foreign manufacture as well as equipment designed, developed and manufactured



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SOVIET RESEARCH IN ACETYLENE CHEMISTRY——*50¢; OTS, U S Dept of Commerce, Washington 25, DC (Report 60-21920)*——Soviet progress in developing an organic chemicals industry is severely handicapped by a lack of originality on the part of Russian chemists and by their reluctance to learn and supply modern chemical structures and reaction theory. This appraisal of the Soviet "state-of-the-art" in organic chemistry research is contained in a five-page summary and analysis of available Russian information prepared by an agency of the Federal Government and released for public distribution through the Office of Technical Services, Business and Defense Services Administration, US Department of Commerce.

"The Soviets have not gone as far as the more scientifically advanced nations of the West in providing a sound organic chemical industry," the report states. "Soviet chemists in the acetylene field are synthesizing a multitude of compounds without appreciably increasing the degree of sophistication of their knowledge of acetylene chemistry. Because of the backwardness of the USSR in fully exploiting the conversion of their vast stores of oil and natural gas through the acetylene route, Soviet progress in plastics, drugs, synthetic rubber, adhesives, and chemical intermediates will be retarded."

At the present rate of development, the report estimates, Soviet research capability in the field will probably show only a slight increase by 1963, and the Russians will continue to depend on technology developed by the United States and Western Europe to assist them in the more advanced areas of acetylene chemistry.

•

STO-FOIL——*Product Service Dept, Stowe-Woodward, Inc, Newton Upper Falls, Mass*——Stowe-Woodward, Inc has made available for general distribution this product bulletin on Sto-Foil—a new and simplified method for testing both the nips and crowns of rubber-covered rolls. The bulletin describes the procedure for taking nip and crown impressions with the firm's patented aluminum foil.

•

THE CRESLAN PRIMER——*Fibers Div, American Cyanamid Co, 111 West 40th St, New York 18, NY*——A consumer's introduction to American Cyanamid Co's acrylic fiber.

The 16-page, full-color brochure defines the performance advantages of Creslan, outlines current end-uses, and answers consumer questions about the fiber's properties. Also included is a "fiber primer," designed to serve as the consumer's guide to the official generic terms in natural and man-made fibers.

One major section of the brochure explains the Creslan quality control program, which confines the Creslan trademark to finished fabrics that have been tested and approved by Cyanamid for specific end uses.

Also cited in the brochure are the company's research leadership and the intensive development program which produced Creslan. A flow chart is included to show the production process for Creslan from the manufacture of acrylonitrile to the spinning and processing of finished fiber at Cyanamid's Santa Rosa Plant in northwest Florida.

•

THIS IS CYANAMID——*American Cyanamid Co, Public Relations Div, 30 Rockefeller Plaza, New York 20, NY*——The booklet describes Cyanamid's growth from a one-product company established in 1907 to a world-wide organization which now manufactures 6,000 products for four major markets: medical, industrial, agricultural and consumer.

•

TEFLON COATING——*Cadillac Plastic & Chemical Co, 15111 Second Ave, Detroit 3, Mich*——Four-page folder describes properties and successful applications for Teflon coating of metal and ceramic parts and tools to contribute antisticking or chemically resistant properties. Procedure for obtaining quotations is outlined.

Successful antisticking applications include: textile size boxes, slasher drums, dyeing cans, drum dryers, fine thread handling equipment, hosiery forms, boot lasts, jigs and reels.

Typical Teflon coating applications are illustrated. The process and limitations of the coating technique are described. Properties of Teflon in solid and in coating form are compared.

TEXTILE FIBERS, YARNS, AND FABRICS——*Fabric Research Laboratories, Inc, 1000 Providence Highway, Dedham, Mass*——A limited reprinting of "Textile Fibers, Yarns, and Fabrics" by Ernest R Kaswell (Reinhold Publishing Corp, 1953, pp 552)—out of print since early 1959—has been undertaken by Fabric Research Laboratories, Inc. The hard-covered reprints, which are very close to original printing quality, were prepared by FRL principally as a service to textile colleges who wanted to use the book but could not obtain copies of it. Limited additional copies, however, are available from FRL at cost, $12 in the continental United States, $13 (to cover handling and shipping) overseas.

•

TURBO ELECTRO-FINISHER——*Turbo Machine Co, Lansdale, Pa*——Four-page bulletin illustrates and describes new model 5KS with six-instrument heat control for woolens, wool blends, and high pile fabrics. Tells how each of the six heating zones on the cylinder is individually controlled from 100° to 600°F with temperatures constant across the face of the cylinder.

•

TURBO MODEL DC CRIMPER——*Turbo Machine Co, Lansdale, Pa*——New bulletin illustrates and describes completely re-designed crimper for synthetic tow production. Tells how stuffing box can be changed easily according to roll width used. Crimper rolls are available in widths from one-quarter inch to six inches. Double and triple tow can be run in continuous operation.

•

TURBO ROTARY DYEING MACHINE——*Turbo Machine Co, Lansdale, Pa*——New bulletin illustrates and describes redesigned machine with outside drive, no gears and bearings within the vessel. Tells how all repairs and replacements can be made without disassembling the machine. Gives data on floor space, steam and water connections for full range of machines from four- to 15-pound capacity to 200- to 250-pound capacity.

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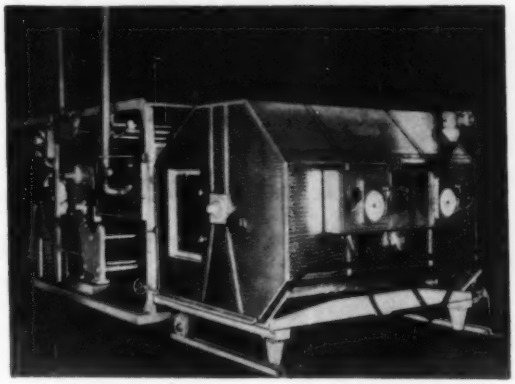

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CORRECTION

YOUR attention is called to an error which appeared on page 104 of the December 12, 1960 in the article, "Some Aspects of Carrier Dyeing" by H Martin Friedman. The illustrations for Figures 6 and 7 were reversed in the printing, and should have appeared correctly as below:

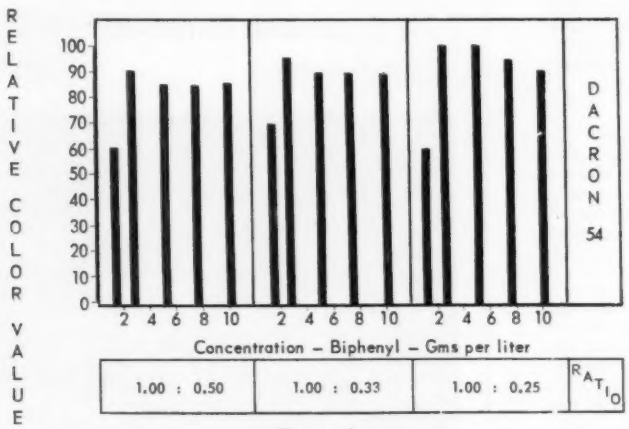

Figure 6
Relative color value on Dacron Type 54
Effect of biphenyl/emulsifier ratio

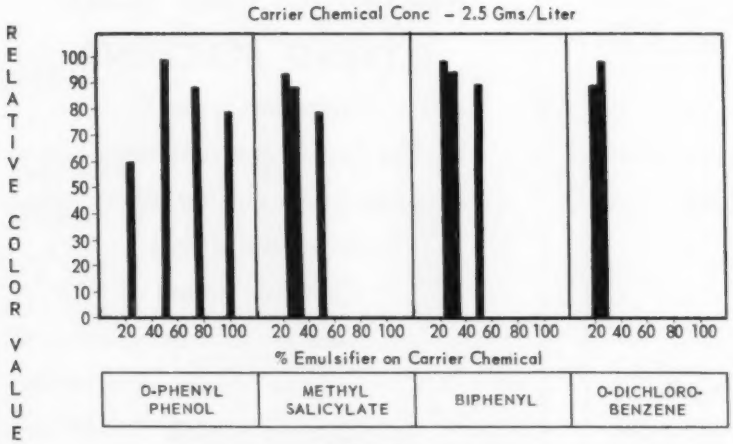

Figure 7
Relative color value on Dacron Type 54
Effect of carrier chemical/emulsifier ratio

Patent Digest———

(*concluded from page 54*)

recovery, and reduction of losses of tensile strength were observed. (Cf col 5, Table I).

Among the references cited by the Patent Office:

U S Pat 2,641,584 (Du Pont/1953) refers to an aqueous adhesive or finishing material containing an amylaceous compound (starch), aluminum sulfate and a triazone, obtained from urea, formaldehyde and a primary amine, as a resinous component.

U S Pat 2,690,404 (Dan River Mills/1954) describes a nonyellowing wrinkle-resistant finish consisting of one mol polymethylolmelamine and 2¼ mols dimethyolethylene urea. [Cf *Am Dyestuff Reptr* 45, 148 (1956)]

U S Pat 2,826,500 (Hercules Powder/1958): cationic triazone-modified urea-formaldehyde resins are advocated for producing wet strength paper.

AICC Using Gas Chromatography Analysis for Neo-Fats

To maintain a record of high-quality fatty acids, Armour Industrial Chemical Company is now using gas chromatography analysis to determine product compositions.

The Company is believed to be the first producer of fatty acids to adopt this modern technique for quality control.

"Product compositions shown by gas chromatography are for the same Neo-Fat fatty acids as produced previously," P L Sheppard, fatty acids sales manager, said. "Only the method of determining composition has been changed to aid in closer control of strict specification processing."

A catalog of 30 Armour Neo-Fats showing specifications and composition under gas chromatography is available by contacting Armour Industrial Chemical Company, 110 N Wacker Drive, Chicago 6, Ill.

●

Cowles Dissolver Model 5-VTV

A new model, the Cowles Dissolver Model 5-VTV, has been added to the Morehouse-Cowles, Inc, line of equipment for mixing, dispersing and deagglomerating. Basic new feature of the 5-VTV is the variable speed drive system with a range of from 1800 to 5400 rpm and allowing for quick changes of speed while in operation.

Designed for small production, pilot plant operations and R & D facilities, the 5-VTV is said to be especially adaptable in critical dispersing and mixing problems over a wide range of processes and materials.

New Model comes equipped with the unique Cowles Impeller in three sizes, 4″, 6″ and 8″. Easily interchangeable, each impeller is especially designed for processing specific materials. Standard impellers and shafts are stainless steel.

Hinge mount permits tilt-back through 45° for easy removal from tanks up to 20″ high. Height in lowered position is 38″. Hydraulic lift enables raising of entire assembly 11″ to maximum of 49″. Impeller will center in container up to 16″ diameter.

Capacity will depend on the nature of product and processing required. The Cowles Dissolver Model 5-VTV is capable of handling a wide range of viscosities up to 50,000 centipoises in 5 to 40 gallon batches.

For full information on the Model 5-VTV write Morehouse-Cowles, Inc, 1150 San Fernando Rd, Los Angeles 65, Calif.

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WANTED: Textile Color Manufacturer has position available in Metropolitan area for man qualified in application and development. . . Replies will be held in strictest confidence. Address all replies to Box No. 988

WANTED: DEVELOPMENT LATEX CHEMIST — Minimum requirements are B. S. in chemistry or chemical engineering, 3 years experience in latex compounding and thorough knowledge of textile applications. Applicant must be capable of formulating natural and synthetic latex compounds for textile application and conducting technical services at customer's plants in Northeastern United States. Send resume of education and experiences to Box No. 991

WANTED: DYER—to supervise dyeing, gilling and blending of all wool and wool/nylon top. Give experience and salary desired. Location: Philadelphia. Write Box No. 994

• OPPORTUNITIES AVAILABLE •

WANTED: TEXTILE CHEMISTS—Two positions, to assist in the development of specifications for dyes, finishes and coatings for cotton fabrics. Several years experience necessary for one position; no experience for the second. Modern, air-conditioned laboratory located on the East coast near universities and other cultural centers. Salary open. Our employees know of these openings. Write Box No. 997

WANTED: PACKAGE DYER—of orlon and other synthetic fabrics. Thoroughly experienced. Salary commensurate with ability. Unlimited opportunity depending upon the imagination and capability of the individual. This outstanding company located in New York City vicinity. All replies confidential. Write Box No. 998

EXPORT SALES: Rohm & Haas wishes to hire a technical salesman for sales and development work in various textile markets throughout the world. Prefer college graduate with experience and language facility. Supply full details with salary requirements if interested. C. S. Betts, Technical Employment, Rohm & Haas Company, 1700 Walnut Street, Philadelphia, Pa.

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POSITION WANTED: CHEMIST AND DYER—Broad experience all phases textile processing. Good background as a technical salesman. Desires position as a Technical Representative for Latin American countries. Fluent Spanish and English. Write Box No. 103

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POSITION WANTED: DYER—Seven years diversified experience plus B. S. in Textile Chemistry. Experience as follows: 2 years continuous and pad-jig as assistant dyer, 5 years experience as color chemist and lab pilot dyer in multi-blend synthetic Beck Dye Plant. Desires change and opportunity for increased responsibility. Write Box No. 108

POSITION WANTED: TEXTILE ENGINEER—B. S. Degree. Ten years plant experience in weaving, dyeing (yarn and piece) printing, finishing. Desires position with progressive sound firm in production, technical service or sales. Write Box No. 109

POSITION WANTED: TEXTILE CHEMIST B.S. Degree with 9 years experience in dyeing, printing, finishing of woven and non-woven fabrics and tufted carpets. Formulation experience in latices and synthetic resins. Seeks position in application research of fiber, resin or latex producer. Write Box No. 992

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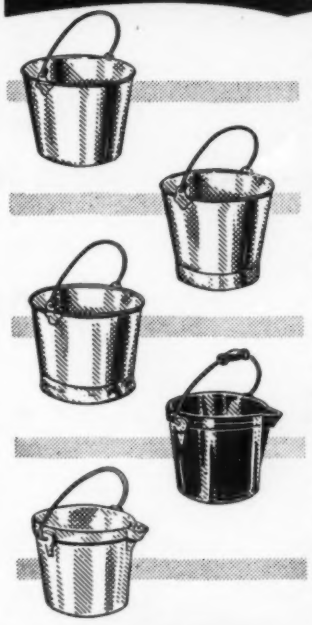

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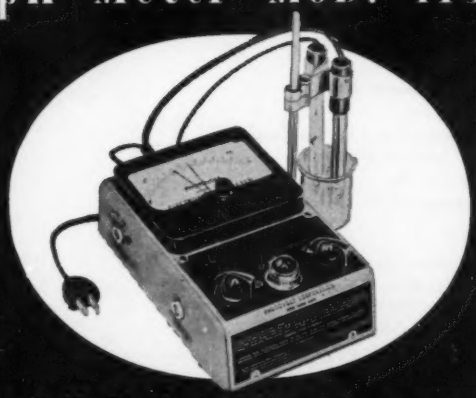

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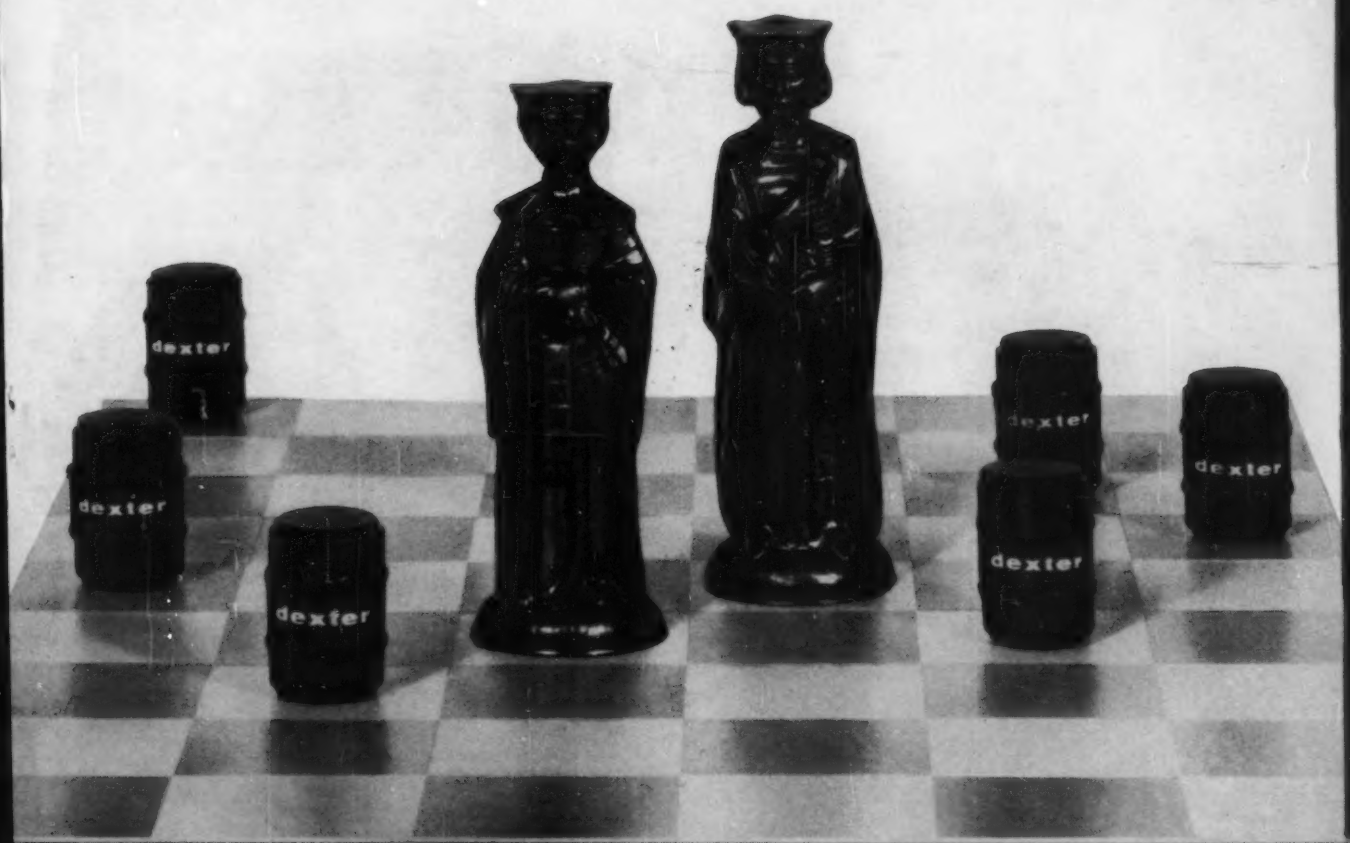

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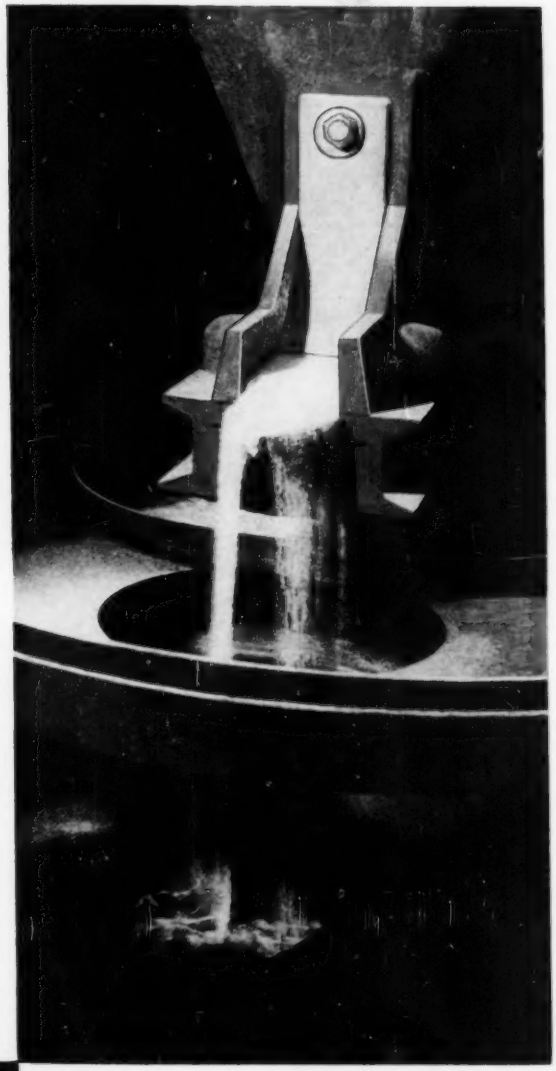

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